RAILWAY MECHANICAL ENGINEER

With which is incorporated the RAILWAY ELECTRICAL ENGINEER

(Names Registered, U. S. Patent Office)

Founded in 1832 as the American Rail-Road Journal

Volume 122 **December, 1948** *No. 12*

C. B. Peck
Editor, New York

E. L. Woodward
Western Editor, Chicago

H. C. Wilcox
Managing Editor, New York

A. G. Oehler
Electrical Editor, New York

C. L. Combes
Associate Editor, New York

G. J. Weihofen
Associate Editor, Chicago

C. W. Merriken, Jr.
Business Manager, New York

New Cars for the Twentieth Century Limited.. 71

Heating Long Trains..... 76

Power Plant Fuel Economy..... 77

Diesel Mechanical Maintenance..... 78

Front Ends—Grates—Ash Pans..... 85

Editorials:

Miles—Or Gallons?..... 87
Cutting the Coal Bill..... 87
A. A. R. Recommendations..... 88
Watch Those Wheels..... 88
A Needed Service..... 88
We Can't Go Back..... 89
New Books..... 89

In the Back Shop and Enginehouse:

Trestle For Diesel Truck Repairs..... 90
Booster Crank Pin Grinder..... 90
Lubricator Tester..... 91
Air Brake Questions and Answers..... 92
Questions and Answers on Locomotive Practice..... 92
Locomotive Boiler Questions and Answers..... 93
Diesel Locomotive Questions and Answers..... 94

With the Car Foremen and Inspectors:

Mechanical Compressor Repairs..... 95
Clamping and Holding Arrangement..... 96
Special Car For Wheel Loading..... 97
Preparing Passenger Cars For Winter Service..... 98
Expandable Emery-Cloth Holder..... 99

Electrical Section:

Brushes for Diesel-Electrics..... 100
Erie's Radiotelephone System..... 103
Black Lighting for Cab Dials..... 107

New Devices:

Sand-Drying Unit..... 109
Air Reduction Introduces New Welding Process..... 109
Motorgears..... 110
Clamps for Armature Winding..... 110
Regulators for Steam Heat Loops..... 111
Journal Box Grease Lubrication..... 111
Liquid Masking Compound..... 111
Diesel Locomotive Ventilator..... 112
2-Kw. Railroad Inverter..... 112
Agitating Cold Cleaning Machine..... 112
Illuminated Reflex Water Gauge..... 112
Pneumatic Grease Gun..... 113
Paint Stripper..... 113
Fuel Additives..... 113
Transformer Turn Ratio Test Set..... 113
High-Temperature Induction Motors..... 113

News..... 114

Index to Advertisers..... 152

Published monthly by

Simmons-Boardman Publishing Corporation

404 Wesley Ave., Mount Morris, Ill. Editorial and executive offices: 30 Church street, New York 7, and 105 West Adams street, Chicago 3. Branch offices: Terminal Tower, Cleveland 13; 1081 National Press bldg., Washington 4, D. C.; 1038 Henry bldg., Seattle 1, Wash.; 300 Montgomery street, Room 805-806, San Francisco 4, Calif.; 530 W. Sixth street, Los Angeles 14, Calif.; 2909 Maple avenue, Dallas 4, Tex.

SAMUEL O. DUNN, *Chairman and President, Chicago;* JAMES G. LYNE, *Executive Vice-President, New York;* S. WAYNE HICKEY, *Vice-Pres., Chicago;* C. MILES BURPEE, *Vice-Pres., New York;* H. H. MELVILLE, *Vice-Pres., Cleveland;* C. W. MERRIKEN, *Vice-Pres., New York;* F. C. KOCH, *Vice-Pres., New York;* ROBERT E. THAYER, *Vice-Pres., New York;* H. E. MCCANDLESS, *Vice Pres., New York;* JOHN R. THOMPSON, *Sales Mgr., Western District, Chicago;* J. S. CRANE, *Sec., New York;* J. T. DEMOTT, *Treasurer, New York;* RALPH E. WESTERMAN, *Asst. Treas., Chicago;* ARTHUR J. MCGINNIS, *Asst. Treas., New York.*

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service. PRINTED IN U. S. A.

Subscriptions, payable in advance and postage free, United States, U. S. possessions and Canada: 1 year, $3; 2 years, $5. Other countries in Western Hemisphere: 1 year, $5; 2 years, $8. All other countries: 1 year, $7; 2 years, $12. Single copies, 50 cents. Address H. E. McCandless, circulation manager, 30 Church street, New York 7.

INTERNAL

When an internal grinding job comes along, simply pull down the internal grinding attachment, lock in position and go ahead.

EXTERNAL

Grinding the taper, 3½" per foot, on the shank end of an attachment drive gear. Notice that internal grinding attachment is up and out of the way. It does not interfere with straight or tapered external work.

CINCINNATI

YOU CAN QUICKLY CHANGE FROM EXTERNAL • TO INTERNAL • TO TAPER SETUPS

FILMATIC

EXTERNAL

CINCINNATI FILMATIC 14" Hydr… …ol with a variet… …eady to … ground.

. . . on Cincinnati Filmatic Hydraulic Universal Grinders

How long does it take to get going on small lots? Whatever the answer is, set-up time constitutes one of the major elements in the cost of small quantity precision toolroom grinding. Reduce set-up time, and costs go down fast. You can be sure of brief setups on CINCINNATI FILMATIC Hydraulic Universals, for they have many features of value in small quantity production. To mention only three: hinged type internal grinding attachment, always on the job; Filmatic spindle bearings, never require adjustment; lathe standard spindle nose on headstock. ¶The photographs above show three toolroom setups which take advantage of CINCINNATI Hydraulic Universals' many features. Others have just as much value in reducing costs. All of them, plus complete specifications, are contained in these catalogs: 12" machine, G-486-4; 14", 16" and 18" machines, G-474-3. Send for copies.

CINCINNATI GRINDERS INCORPORATED

CINCINNATI 9, OHIO, U. S. A.

CENTER TYPE GRINDING MACHINES • CENTERLESS LAPPING MACHINES • CENTERLESS GRINDING MACHINES

The Lookout Lounge Car

New Cars for the

Twentieth Century Limited

A two-car dining-room-kitchen-dormitory unit, all-room sleeping cars, and a Lookout Lounge are features of the new trains

THE New York Central placed in service two new Twentieth Century Limited trains on September 15, one departing from New York and one from Chicago. The new trains normally comprise about 16 all-room sleeping cars with lounge and dining-car facilities. They were built by the Pullman-Standard Car Manufacturing Company and are being hauled by 4,000-hp. two-unit Diesel locomotives built by the Electro-Motive Division of the General Motors Corporation. Complete with motive power, the equipment cost about two million dollars per train.

The cars are built of welded low-alloy, high-tensile steel and were designed by the car builder in co-operation with the railroad's engineers. Interior decorative treatment was developed by Henry Dreyfuss, industrial designer, New York. All lighting is fluorescent, operating on a railroad designed circuit from a 64-volt battery without motor alternator or other convertor.

In addition to the railway post-office car, equipment in the train includes the following types: 22-roomette; 10-roomette and 6-double-bedrooms; 12-double-bedrooms; a full-length diner; kitchen-dormitory; lounge-barber-secretary, or club car; and 5-double-bedroom-lounge-observation, called the "Lookout Lounge."

To tie the train together as a unit, uniform color schemes, upholstering, paneling and general treatment are used. The new Century exterior is painted in the traditional shades of Century gray, with aluminum striping, a light gray panel being used between windows, and darker gray above and below.

Sleeping accommodations in the normal 16-car train comprise 137 units with 253 beds.

Full-Length Diner and Kitchen-Lounge

The diner is a full-length car, seating 64 persons. It is divided into five separate sections. In the center section is dining space for 24 passengers on continuous leather serpentine seats along the walls. At either end of the main dining section, separated by winged partitions, are four dining tables. At one end of the car is additional dining space; the other end section is furnished with built-in settees where passengers may enjoy cocktails before meals.

Over each table is a pair of Luminator lenses that give additional direct illumination on the tables.

Connected to the dining car is a kitchen-dormitory car, with an electric-eye door-opening mechanism for waiters carrying loaded trays, to speed service. The entire kitchen is of stainless steel. Behind this large kitchen is the dining-car-crew dormitory, sleeping 15 persons.

The kitchen and dining cars are equipped with Frigid-

aire electric refrigerators and an electric dishwashing machine is installed in the kitchen. The refrigerators include a low-temperature cabinet for ice cream and frozen foods, and a large provision refrigerator, in which is an isolated box for storage of sea food. In the pantry is a dairy and cheese box, a refrigerated storage bin for ice cubes and a large vegetable box, refrigerated by two ice-cube freezing units. In the dining-room car is a large beverage refrigerator, also cooled by two ice-cube units.

Filtered fresh air is supplied to the kitchen by a centrifugal blower, through a duct near the ceiling opposite the range. A frost-proof steam radiator, controlled by a manually operated steam valve tempers the incoming air during the winter. A propeller-type fan draws air from the pantry into the kitchen which causes a movement of air from the entrance to the dining room.

At the rear of the warming ovens over the range ducts lead up to a single centrifugal type exhaust fan which draws air over the top of the range. Centrifugal exhaust fans are also installed above the steam table and the dish washer. All fans are controlled by a single three-position switch, so that the air intake and exhausts will always be in balance.

The range and broiler have stacks which are equipped with an aspirator drafting device developed by the New York Central. A centrifugal blower fan supplies air to aspirator nozzles set in the stack to increase draft.

Club and Lookout Lounge Cars

At the front end of the club car is a completely equipped barber shop with valet facilities, and a shower bath. Behind the barber shop is a train secretary's office, with full equipment, including a dictaphone with a free-of-charge train secretary in attendance.

The lighting in the club car has been designed around a large wall mirror so that reflections in the mirror make the car appear twice its normal width. The effect of a large rectangular luminous ceiling has been created by using the vertical space between the two-level ceiling to apply a continuous row of Luminator lenses and give a high level of glareless, shadowless light over the center section of the car. Elsewhere, individual seats are lighted by fluorescent units in the ceiling over each seat.

A booth next to the secretary's office features radio-telephone service, where passengers may phone their office or home while the train is running both ways between New York and Buffalo. Later, as additional radio-telephone stations are built, service will be extended the remaining distance between Buffalo and Chicago.

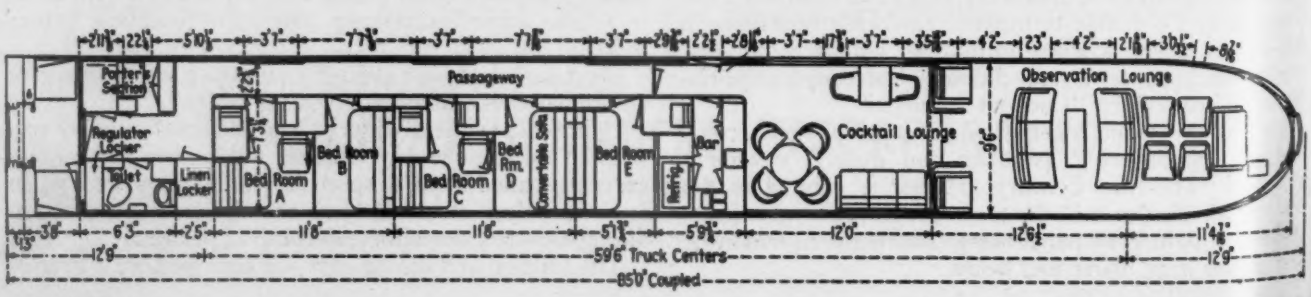
Behind the phone booth is a service bar for the lounge section which occupies the remainder of the car.

The Lookout Lounge car features an observation end with floor raised 12 in. above the normal floor level, extra large windows for greater visibility, and chairs and sofas, seating 14 passengers. The section forward of the raised observation end, and separated from it by Tuf-flex glass partitions, is a lounge with a service bar. On a panel in this section is spotlighted an original contemporary oil painting, loaned by the Grand Central Galleries in New York, and changed periodically. The railroad has approximately 400 reproductions of masterpieces hanging in the cars of its various trains, but this is the first time it has displayed gallery paintings on any train. Forward of the lounge are five double bedrooms.

Interior Decorations

In the observation end of the Lookout Lounge, with raised floor level and extra high windows, a light-green

Left and below: The Lookout Lounge and floor plan of the car—Right: Seating and lighting arrangements in the club car



Light Weights of the Cars in the New "Twentieth Century Limited" Trains

Car type	Light weight, lb.
Railway post office	127,000
Kitchen-dormitory	137,200
Dining	119,525
Lounge-barber-secretary	124,250
22-roomette	141,100
10-roomette, 6 double-bedroom	138,800
12-double-bedroom	132,490
5-double-bedroom-lounge-observation	130,200

ceiling increases the effect of spaciousness. Upholstery in this and the forward lounge includes bright red and gun-metal leather and soft gray beige fabric. The coffee-table tops are black Formica and window sills gray Formica. Two steps leading to the lower level are flanked by solid metal hand rails, designed as part of the Tuf-flex glass partitions separating the two areas.

The chairs in the forward lounge and Flexwood on the window zone and pier panels are bleached walnut. The floor is covered with a soft brown loop carpet.

In the partition at the forward end of the lounge, which separates it from the five double-bedrooms, light-green leather is recessed in the wood veneer to form a background for the spotlighted framed original oil painting which is displayed. A snack bar is also part of the appointments of the lounge.

The color scheme in the club car is similar to that in the Lookout Lounge.

In the dining car, lighting is direct-indirect, patterned to repeat in the mirrors. Bright red leather wing partitions, tooled with silver lines, separate the center section from the adjacent intermediate sections. The chairs are covered in blue-green leather. Walls and ceiling are light gray-brown.

A Tuf-flex glass partition forms an intimate end section with tables for four on either side. Walls and ceiling, a slightly darker gray-brown than the adjacent areas, are offset by the leather upholstering which matches the red of the leather fins in the center section. At the opposite end of the car, the end section has two built-in settees upholstered in red leather. Pier panels in the end and intermediate sections are covered with gray and silver drapes. The carpet is brown loop.

The all-room sleeping cars appear in two major color schemes. In one, the mohair upholstery and carpet is rust; in the other, the color is green. In each car the color scheme in all rooms is uniform.

Lighting Equipment

The lighting in the sleeping cars was developed through close collaboration between New York Central and Luminator, Inc. The fixture finally developed is similar to a luminous moulding and is located in the corner directly over the seats. The high-intensity beam of light is directed through a clear condensing lens to the reading plane, while the diffused area immediately above the lens provides the general illumination.

Lighting in the bedroom with the bed crosswise consists of a five-light unit in the form of a letter L. It is so wired that when the occupant of the upper berth wishes to read, he can turn out the four bulbs running across the car and use only the short length fixture directly over his head as a night reading light. Provision is made for a blue night light as well. For the lower berth, a new type of reading light fits on the surface of the wardrobe. This unit serves not only for night occupancy, but for day use as well.

In the bedroom with the bed in a longitudinal position, there is a two-lens unit with four lamps for the general illumination in this space. On the pier panel is a new fluorescent reading light for day use. In addition, both the upper and lower berths have night reading lights. In the toilets, a fluorescent unit is placed across the top of each mirror.

In the roomettes, the same type of fixtures used in the bedrooms are located over the passengers' heads, while on the other partition there is a similar unit located between the mirror and the parcel rack above. The night reading light is back of the folding bed.

Electric Power

Electric power is supplied by a G.E. 30-kw. axle-driven motor-generator set on the kitchen car, and 20-kw. motor

The kitchen

Table and seating arrangement in the sectionalized full-length diner

One of the bedrooms with longitudinal beds

generator on all other cars. The sets are operated by Spicer mechanical drive from a truck axle, or from three-phase, 220-volt a.c. standby power in yards and terminals. Twenty-five-horsepower motors are used with the 30-kw. generators and 15-hp. motors with the 20-kw. generators. There is a three-phase, 220-volt a.c. standby power receptacle on each side of each car.

Air Conditioning and Heating

All passenger compartments are air conditioned, using the New York Central modulated system, furnished by Frigidaire on each car and an Anemostat air-distributing system in the sleeping-car rooms. The evaporator is in two sections to provide modulated cooling, without complete on-and-off cycling.

The cars are heated by the Vapor zone-control system with both overhead and floor heat. The central control of air conditioning and heat in each car is effected by a single switch; movement of the switch to one side of the off position brings the heating system into operation and movement to the other side starts the air-conditioning system. The selection having been made, the operation is automatic, under thermostat control.

Each room has three temperature controls. All are effective when the car is being heated, and one of them also operates during cooling. An automatic floor-heat-control switch can be operated to control the room temperature between a minimum of 65 deg. F. and 80 deg. F. A manual remote control is also available to shut off the floor-heat steam completely if the occupant so desires. Its principal function is to serve as a protection in case of a failure of the automatic temperature control. A damper in the air duct can be operated by the occupant to control the amount of air admitted to the space. With the exception of the manual remote-control steam valve, these controls and the light and fan switches are all arranged in a single small panel.

Partial List of Materials and Equipment on the New N.Y.C. "Twentieth Century Limited" Trains

Trucks	General Steel Castings Corp., Granite City, Ill.
Truck springs	Crucible Steel Company of America, New York
Truck locking center pins; side bearings	W. H. Miner, Inc., Chicago
Roller bearings with hot-box alarms	Hyatt Bearings Div., General Motors Corp., Harrison, N. J. Timken Roller Bearing Co., Canton, Ohio
Wheels	Armco Steel Corp., Middletown, Ohio Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Axles	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Shock absorbers	Houde Engineering Div. of Houdaille-Hershey Corp., Buffalo, N. Y.
Draft gear	Waugh Equipment Co., New York
Couplers and unlocking mechanism; coupler yokes	National Malleable & Steel Castings Co., Cleveland, Ohio
Center-plate, body side-bearing, equalizer coil spring, and journal-box pads	Fabreeka Products Co., Boston, Mass.
Air brakes	New York Air Brake Co., New York
Clasp brakes	American Steel Foundries, Chicago
Brake shoes	American Brake Shoe Co., New York
Hand brakes	National Brake Co., New York
Steel plates and sheets	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Platform floor covering	Alan Wood Steel Co., Conshohocken, Pa.
Flooring, composition:	
In kitchens	Crossfield Products Corp., Brooklyn, N. Y.
Except in kitchens	Tuco Products Corp., New York
Window sash	Adams & Westlake Co., Elkhart, Ind. (lounge sleepers) O. M. Edwards Co., Syracuse, N. Y. (room sleepers) Libby-Owens-Ford Glass Co., Toledo, Ohio
Glass	Pittsburgh Plate Glass Co., Pittsburgh, Pa. Libby-Owens-Ford Co., Toledo, Ohio
Vestibule curtains	Morton Mfg. Co., Chicago
Window-sill capping	Formica Insulating Co., Cincinnati, Ohio
Insulmat	J. W. Mortell Co., Kankakee, Ill.
Insulation	Gustin-Bacon Mfg. Co., Kansas City, Mo.
Motor generator for lighting and electric motors	General Electric Co., Schenectady, N. Y.
Motor generator drive	Spicer Mfg. Corp., Toledo, Ohio
Voltage regulators	Safety Car Heating & Lighting Co., New York
Storage batteries	Gould Storage Battery Corp., Depew, N. Y. K. W. Battery Co., Chicago
Train-line jumpers for batteries; charging receptacles	Pyle-National Co., Chicago
Train-line jumpers for radio and telephone inter-car connections	Mines Equipment Co., St. Louis, Mo.
Inverters for electric razors	Cornell-Dubilier Electric Corp., South Plainfield, N. J.
Steam heat and controls	Vapor Heating Corp., Chicago
Flexible metallic heat connectors	Barco Manufacturing Co., Chicago Vapor Heating Corp., Chicago
Heat specialties	Vapor Heating Corp., Chicago
Steam-pipe covering and fittings	Johns-Manville Corp., New York
Air conditioning; mechanical refrigeration kitchens, diners and bars	Frigidaire Div., General Motors Corp., Dayton, Ohio
Air filters	Air Maze Corp., Cleveland, Ohio
Recirculated air grilles	Barber-Colman Co., Rockford, Ill.
Air diffusers	
(rooms)	Anemostat Corp. of America, New York
(open cars)	E. A. Lundy Co., New York
Exhaust fans for discharging air from refrigerator units	L. J. Wing Mfg. Co., New York
Exhaust and blower fans for kitchen and pantry	Westinghouse Electric Corp., Pittsburgh, Pa.
Kitchen, bar room, and pantry equipment	Angelo Colonna, Philadelphia, Pa.
Furniture in lounge	S. Karpen & Bros., Chicago
Dining-car chairs; folding chairs in sleeping rooms	General Fireproofing Co., Youngstown, Ohio
Upholstery	Goodall Fabrics, Inc., New York Massachusettes Mohair Plush Co., Boston, Mass. Shelton Looms, New York
Leather	Cleveland Tanning Co., Cleveland, Ohio Eagle-Ottawa Leather Co., Grand Haven, Mich.
Foamrubber mattresses	Hewitt Rubber Corp., Buffalo, N. Y. United States Rubber Co., New York
Carpet	Mohawk Carpet Mills, Inc., Amsterdam, N. Y.
Flexwood veneers (lounge cars)	United States Plywood Corp., New York
Partitions	Haskelite Mfg. Corp., Chicago
Window curtain fabric	Pantasote Co., New York
Venetian blinds, lounge car	Ajax-Consolidated Co., Chicago
Window curtain fixtures	Adams & Westlake Co., Elkhart, Ind.
Fluorescent lighting fixtures	Luminator, Inc., Chicago
Radio in lounge rooms	Dormitzer Corp., Boston, Mass.
Dictaphone	Dictaphone Sales Corp., New York
Hardware	Adams & Westlake Co., Elkhart, Ind. Dayton Mfg. Co., Dayton, Ohio H. S. Getty & Co., Philadelphia, Pa. Yale & Towne Mfg. Co., Stamford, Conn.
End door opener and closer	National Pneumatic Co., Rahway, N. J.
Magic door controls for full-length diner	Stanley Works, New Britain, Conn.
Annunciators, call bell and chime (in sleepers)	Edwards & Co., Norwalk, Conn.
Sound-powered telephone receivers	United States Instrument Corp., Summit, N. J.
Inter-car telephone	McKee Electric Co., New York
Hoppers in general toilets	Dayton Mfg. Co., Dayton, Ohio

Toilet facilities, sleeping rooms, toilet seats	C. F. Church Mfg. Co., Holyoke, Mass.
Washstands in general toilets	Crane Co., Chicago
Paper holders	Geo. T. Johnson
Water coolers	E. A. Lundy Co., New York
Prism glass in toilets	Pressed Prism Plate Glass Co., Morgantown, W. Va.
Exhaust fans in toilets	Diehl Mfg. Co., Somerville, N. J. Safety Car Heating & Lighting Co., New York
Paint:	
Exterior	E. I. du Pont de Nemours & Co., Wilmington, Del.
Interior	Glidden Co., Cleveland, Ohio Pratt & Lambert, Inc., Buffalo, N. Y. Sherwin-Williams Co., Cleveland, Ohio
Electric marker lights	Lovell-Dressel Co., Arlington, N. J.
Fire extinguishers (kitchen)	Walter Kidde & Co., Belleville, N. J. American-La France-Foamite Corp., Elmira, N.Y.

Circulating Drinking Water

The drinking-water circulating system consists of a loop of ⅜-in. tubing from which ¼-in. tubing leads to the faucets in the rooms. To cool and circulate the water a heat exchanger, a motor-driven refrigerant compressor and condenser, and a water-circulating pump are resiliently mounted on a rigid frame installed in a locker inside the car. By breaking refrigerant, water and electrical connections outside the unit, it may be removed from the locker for repairs.

The Lundy heat exchanger consists of closely adjacent coils of small copper refrigerant and water tubes in a solid cast ring of aluminum. The size of the tubes and the surrounding aluminum insures the unit against damage from freezing and provides a highly efficient heat transfer.

The water pump develops sufficient pressure to overcome the friction of the circulating loop and keep the small volume of water in the loop circulating slowly. The temperature of the water is maintained automatically at 50 deg. by thermostatic control of the refrigerant system. When drinking water is drawn from a faucet, the pressure on the water-supply system forces water into the cool-water system through a check valve at the intake side of the heat exchanger.

Air for cooling the condenser is withdrawn from the corridor of the car through louvres in the locker door and exhausted into the general toilet.

With water at 90 deg. F. at the intake, the system has a capacity for cooling 5 gal. per hr. to 50 deg. F. at the faucets.

Radio and Telephone Communication

The intercommunicating telephone and public address system each employs four-wire circuits running the full length of the train. Except the dining cars, each car equipped has a control panel and hand set located behind a flush steel cabinet in the passageway at the end of the car. Each dining car is equipped with a portable phone which plugs into a flush panel at the steward's work section. The hand sets are sound-powered and serve also as microphones for the public address system. All cars, except sleepers, are fitted with loud speakers.

Operation of the dial at the calling station moves all stepping switches to the desired number. Pressing the buzzer push key operates all buzzer relays, local buzzers, and a light signal on the car dialed. When the system is in operation, a light indicates whether telephone or public address circuit is in use.

The telephone and address system combine to provide a number of services, such as arranging for dining-car seating, paging recipients of telephone calls on the radio telephone in the club car, the making of announcements, etc. There is also a rear brakeman's telephone installed under the car at the observation end. There is a possibility of extending telephone service to the locomotive.

An intercommunicating telephone hand set and control panel

Mechanical Equipment

Except for the mail car, the trucks are four-wheel, with 36-in. rolled-steel wheels mounted on roller-bearing axles. The axle sizes are 6 in. by 11 in. on the kitchen-dormitory car and on all of the full room cars. On the dining car and the lounge-barber-secretary car the journals are 5½ in. by 10 in. The front truck of the bedroom-lounge-observation car has 6-in. by 11-in. axles and the rear truck 5½-in. by 10-in. axles. The mail car has six-wheel trucks with 5½-in. by 10-in. axles. The journal boxes are equipped with hot-box alarms. The four-wheel trucks have single drop equalizers with General Steel Castings alloy-steel frames, on which the pedestals are cast integral. Both the equalizer and bolster springs are helical coils. Fabreeka sound-deadening materials are installed under the center plate, the body side bearings, at the ends of the equalizer coil springs, and over the journal boxes.

The cars are equipped with HSC electro-pneumatic brakes with decelostat anti-slip control. The trucks have clasp brakes with two truck-mounted cylinders.

The cars have tight-lock couplers and Waughmat draft gears.

Information regarding additional details of these new "Twentieth Century Limited" cars is given in the table of specialties and materials used.

EQUIPMENT DEPRECIATION RATES.—Equipment depreciation rates for the Chicago Great Western and Bangor & Aroostook are among those prescribed by the Interstate Commerce Commission in a new series of sub-orders in the general proceeding, Depreciation Rates for Equipment of Steam Railroad Companies. In both cases, the present sub-orders are modifications of previous sub-orders. The new rates for the C.G.W. are: Steam locomotives, 3.05 per cent; other locomotives, 4.59 per cent; freight-train cars, owned, 3.01 per cent, leased, 3.6 per cent; passenger-train cars, 3.4 per cent; work equipment, 4.13 per cent; miscellaneous equipment, 19.32 per cent. The new B. & A. rates are: Steam locomotives acquired new, 3.08 per cent, acquired second-hand, 20.89 per cent; other locomotives, 4.9 per cent; freight-train cars, all-steel, 3.81 per cent, cabooses, 2.72 per cent, other 3.45 per cent; passenger-train cars, all-steel, 3.09 per cent, other, 2.51 per cent; work equipment, 3.38 per cent; miscellaneous equipment, 20 per cent.

Heating Long Trains

By H. L. Gillick*

THE basic requirements for heating passenger trains of any length come back to the amount of steam used per car per hour, which is dependent largely on the speed of operation. It has been found that a well-constructed and insulated car will use from 250 to somewhat over 350 lb. of steam per car per hour and that is the figure which is kept in mind in considering a steam source with Diesel or steam locomotives.

The length of train which can be heated depends on the size of the steamline from the locomotive through the train and the insulation of that steamline. The newer equipment which is now being built with 2½-in. trainlines can be heated satisfactorily if a volume of 350 lb. or steam per car per hour is available at proper pressure (ranging up to 250 lb. per sq. in.) from the locomotive and if the train is limited to not more than 16 to 20 cars in below-zero weather.

Train Line Size a Limiting Factor

When cars are of the older type with 2-in. train lines, the problem changes because the 2-in. train line in itself does not have sufficient steam carrying capacity to permit heating a long train. Experience shows that, while the cars themselves will use a maximum of 250 to somewhat over 350 lb. of steam per car per hour (depending on speed, weather, etc.), under maximum conditions the 2-in. train line will conduct steam back to heat properly only a 12 to 14-car train in below-zero weather at high speed. This is true whether the source of steam be a steam locomotive or a Diesel locomotive with a steam boiler of adequate size. Train line size and insulation are the limiting factors.

Where trains longer than 12 to 14 cars with 2-in. train lines or 16 to 20 cars with 2½-in. train lines are contemplated, it is beginning to be accepted on the railroads that these trains must not be handled in below-zero weather at high speed, unless a boiler car of some sort is provided to take care of heating the last cars in the train. This boiler car could be the last car in the train and would furnish steam to the train line at that point.

There has been a tendency also to add more cars to trains than the boiler capacity of either steam or Diesel locomotives is adequate to heat. A train running at high speed must have a sufficient supply of steam to give a minimum of 20 lb. per sq. in. pressure in an air-conditioned car to heat it.

In some instances, the boiler capacity has been sufficient to take care of 12, 14 or 15 cars, and these same trains often operate with 16, 17 or 18 cars. The result has been that the trains cannot be properly heated under adverse conditions. The steam consumption obviously has a direct relation to the number of cars and the length of train line, and sufficient steam must be provided to fill that train line and heat all cars.

A new idea is now being developed of multiple boilers in Diesel locomotives to give excess capacity so that there will not be the tendency to have heating failures in cold weather for any minor deficiency which might prevent the boiler developing its maximum capacity. Multiple boilers should give considerably improved performance, because they will insure that, even though some slight falling under maximum capacity might develop, there will be a reserve of steam to take care of longer trains under the most severe conditions. In too many cases, boilers have to operate at 100 per cent capacity on Diesel locomotives in order to heat the cars which are being hauled, and, with the present limited maintenance time allowed, this high boiler output is difficult to maintain. Therefore, reserve steam capacity should improve heating conditions.

The problem of heating long passenger trains has each year come a little closer to solution. It is not a product of the Diesel locomotive. It comes when trains have too many cars or run at too high speed for the amount of steam supplied, whether the steam source be a steam locomotive or a boiler in a Diesel locomotive. It can be solved by a realistic evaluation of the steam requirements for any given train. If the boiler supply is inadequate to furnish the required amount of steam with a proper excess to protect against emergencies, then (1) fewer cars should be handled during severe winter weather; (2) additional steam should be made available possible through the use of rear-end heater cars; or (3) additional capacity should be obtained by adding to the boilers in the Diesel locomotive. Always the size and insulation of the train line are limiting factors.

Insulation Also Important

Some railroads are recognizing the fact that larger and better insulated train lines can materially improve these heating conditions and are adopting policies of replacing present 2-in. train lines with the new 2½-in. lines when cars are shopped. At the same time, these railroads are applying the latest and best approved practices in insulating steam train lines against wind wipe, radiation losses, and contact with car structure. Proper attention to insulation materially improves heating conditions in severe weather and those railroads most affected by cold weather should exert every effort to keep proper insulation on their train lines.

Whenever the steam supply falls below a minimum of 20 lb. pressure in any car when the train is running at speed, proper recognition should be given to the need of an additional volume, or the length of the train must be reduced during severe weather.

In the future, it is felt that the railroads will insist on reserve capacities of steam to insure an adequate supply to take care of demands under all conditions. Equipment has been developed to insure such a supply.

FREIGHT CAR PRODUCTION.—Freight cars produced during October for domestic use totaled 8,934, including 2,285 built in railroad shops, compared with September production of 9,753, which included 2,775 built in railroad shops, according to the American Railway Car Institute. October production included, the institute said, 2,888 box cars, 3,112 hopper cars, 1,536 gondola cars, 649 refrigerator cars and 749 other cars of various types. The backlog of freight cars on order and undelivered on November 1 was 111,405, including 39,685 on order from railroad shops. During October domestic railroads placed orders for 11,431 new freight cars, according to William T. Faricy, president of the Association of American Railroads. Of the cars ordered 9,515 are to be built in railroad shops and 1,916 will be turned out by the carbuilders. Mr. Faricy added that since the end of the war the railroads have installed more than 200,000 new freight cars.

*Vice-president, Vapor Heating Corporation, Chicago.

Power Plant Fuel Economy*

Railroad power plants (in using this term, heating plants are included) can be classified with the small and medium size industrial power plants, in order to distinguish them from modern utility plants which are constructed mainly for the purpose of generating electrical energy.

In the eastern part of the United States, coal is the primary fuel. While in the midwest, south and west, gas and oil are available, natural gas only is comparable in price at the present time to coal, oil being much higher in cost. The first step in any fuel economy program as related to power plants

Steam generating plants on railroads are lacking in uniformity of design without automatic controls and are operated by men whose training has been much less specific than that of the other crafts. Maintenance is unplanned and frequently neglected. Experience has shown that correction pays dividends.

is the selection of the best available fuel which will give the lowest cost of power plant output. This is not always the cheapest fuel available.

The second step is, the installation of the most modern type of boiler and engineroom equipment and the use of modern combustion control equipment, and instruments to determine and maintain the highest efficiency in the burning of fuel and the use of heat energy.

The third, and one of the most important steps is either to employ or educate a personnel who are capable of operating and maintaining the plant in the most efficient condition. This is one of the most important steps toward fuel economy.

The fourth step is carefully to patrol and investigate to see that waste due to carelessness in maintaining and operating steam lines, water lines, electric power lines, and various services supplied by the power plant is eliminated.

Character of Railway Power Plants

The majority of our power plants were built and equipped during the cheap fuel era and were designed primarily to serve terminal facilities, such as roundhouses and shops. Later extensions to pipe lines and electric lines were made to enable these plants to serve offices, stations, and other equipment such as water, oil and fuel facilities.

As business increased, additional heat and power were needed. Units were added, usually in an emergency. In some cases, consideration was given to future needs and excess capacity was installed, but efficiency of operation was given too little consideration, since fuel and labor were relatively cheap. First cost of equipment was given first consideration.

Up to 1940 most railroads found themselves with a number of terminal power plants composed of a large variety of equipment designed by many manufacturers. Much of it is obsolute, though still serviceable, and a small amount is modern.

The chief mechanical officer of a certain railroad realized the necessity of having power plants which were capable of operating at peak efficiencies and capacities due to the war emergency. At the beginning of the war, he instituted a program to economize in the use of fuel and to improve his power plants and keep them in first-class operating condition. There were approximately seventy terminal power and heating plants concerned in the investigation. During 1940, the total tons of fuel used in these plants was approximately 447,540 tons annually. During the war emergency it finally increased to a total of approximately 604,100 tons annually.

An inspection of these plants revealed that about 30 per cent of this fuel was preventable waste,* with about 15 per cent "recoverable waste".†

Conditions Within the Plants

Suppose we take a hypothetical inspection trip through a number of average small and medium size power plants. We would probably find that the maintenance of these plants was left to circumstance rather than design. For example, we might find turbines that had not had proper oil changes, others that had not been open for inspection and overhaul for a number of years, engines and generators not being overhauled until failure, air compressors and pumps that had not had general inspections or overhaul for a period of years.

In boiler rooms, conditions would be about the same: no regular cleaning periods for feed water heaters and boiler feed lines, superheater inspections overlooked, boilers being washed regularly, but not cleaned, furnace walls allowed to deteriorate to complete failure without report or repairs, boiler baffles of improper design on water-tube boilers for highest capacity or efficiency. Boiler inspections are too casual, with not enough attention to cleanliness of inside and outside of heating surfaces, and proper tube cleaning, especially in bent-tube water-tube boilers.

We would find few automatic combustion controls and few combustion instruments, especially in the smaller plants, and that, where the combustion controls were installed, they were being used to control steam pressure only and not being operated to increase efficiency.

We would also find that firing equipment, such as gas and oil burners and stokers, was not selected for the highest efficiency or capacity and that furnaces were, in many cases, inadequate; therefore, many of the boilers were being operated at capacities and efficiencies far below those attainable.

The overall condition of any one of these plants would be a reflection of the level of intelligence, experience and loyalty of the power-plant personnel and especially the man in charge of the plant, as well as the co-operation which he receives from his supervising officers.

We would possibly find that few accurate records of the progressive condition of the equipment or frequency and cost of repairs were being kept and made available, since, in most cases, power-plant accounting is a matter of office routine.

Some excuse can be made for inefficient operating personnel since there is usually no specific or enforced training or educational program for this class of work such as in the other crafts. Many of the personnel have been placed in the power plants without previous education in the operation of steam equipment and many of these men have too little fundamental education to be properly trained, except in a few practical details.

We would probably find that the feed water being used in our power plants would be that which was conditioned for locomotive service. Unless careful cooperation was being maintained between the chemical department and the operator of the stationary boiler plant, there would be fuel waste due to the use of boiler water improperly conditioned for use in stationary boilers.

We would recommend the installation of oil meters, gas meters and provisions for weighing coal consumed where necessary, that a continuous blowdown be installed on all boilers and a careful daily check of boiler water concentration be made and recorded. We would insist that all boiler inspections should be thorough and the condition of the boilers be reported in detail after each inspection. No accumulation of scale would be allowed and boiler cleaning periods would be set at six months where possible, and boiler feed water corrected to that end. This would reduce boiler standby capacity and materially reduce the cost of boiler operation. Each plant, of course, is a specific problem.

*From a report presented at the September, 1948, meeting of the Railway Fuel and Traveling Engineers' Association.

† "Preventable waste" is what could have been prevented by perfect operation with modern equipment. "Recoverable waste" is what could have been prevented by better operation and maintenance with the present equipment installed in the plant.

We would recommend that furnaces and firing equipment should be improved and corrected to allow operation at the highest capacities and efficiencies and that measuring automatic combustion control should be installed where needed, especially in the larger plants, to effect a labor saving and a fuel economy. We would insist that necessary combustion instruments, such as CO_2 meters, draft gauges and recording stack pyrometers be installed in all boiler rooms, as well as boiler flow meters, where needed, and that they be carefully maintained. Boiler operators should be required to operate their boilers by instrument in place of by guess.

For improved operation in engine rooms we would recommend that steam pressures be carried at the highest level possible and back pressures as low as possible, that condensing equipment be installed where feasible, that in each plant a complete system of maintenance should be worked out for each machine and periodic inspection and repairs made, and a record kept. A clear-cut understanding should be worked out for each plant as to what repairs are to be made by the power-plant personnel, what repairs are to be made by the local mechanics, and to what exent other forces are to assist in maintaining the equipment.

We would recommend that all governors and automatic controls be maintained in best operating condition, that all power-plant instruments be kept in operating condition and daily inspection of this equipment by the power plant personnel be made imperative.

We need a systematic planned procedure for inspection and maintenance of all power plant equipment, and an accurate record of efficiency of operation and the frequency and cost of repairs. Proper maintenance of equipment will release considerable standby equipment for use in plants where it is needed for continuous duty, at a considerable saving.

We would recommend that, where extensive repairs are necessary to boilers and furnaces, these be corrected to present day design to obtain the maximum efficiency and capacity. Obsolete equipment should be either replaced or improved, where the saving would justify the expenditure.

After making the detailed inspection and recommendations for improvement of the power plants, we would most certainly concern ourselves with the facilities which the power plant serves to reduce waste by the elimination of water, steam and air leaks, and reduce unnecessary use of electricity. We would find many steam lines improperly lagged—would find buildings heated at times when it is unnecessary, many of them overheated, and lights burning where not needed. We would find complex systems of pipe lines, some of which could be simplified, reducing the amount of pipe needed, which would reduce radiation loss. We would find high-pressure live steam being used where low-pressure exhaust was being wasted.

If we could, by ordinary efforts, reduce the consumption of fuel by 15 per cent which was done in many plants with which I am familiar, we would save annually 150,000 tons of fuel per million tons consumed, which, at present prices, would total nearly a half million dollars annually.

This report was prepared by a committee of which B. E. Clark, electrical supervisor, Atchison, Topeka & Santa Fe, was chairman.

Discussion

The problem of fly-ash elimination from stationary power plants was referred to by several persons. The cost of precipitators, it was said, is prohibitive for power plants the size of most of those on the railroads. Questions brought out several facts concerning direct-steaming for use in connection with firing up locomotives. The author referred to an article in the January, 1944, issue of *Railway Mechanical Engineer* which describes the direct-steaming process. The principal saving from direct steaming, he said, is not fuel, but reduced boiler maintenance. Pressures of from 75 to 100 lb. are developed in the locomotive boiler which is enough to move the engine outside for firing up.

The lack of planning of efficient power plants on the railroad was decried. Fly ash from stationary plants is now a recognized public nuisance and should be dealt with by the railroads.

In closing, Mr. Clark referred to the great waste of exhaust steam at railway power plants because the steam-using facilities are so frequently too far away to permit the exhaust to be used. He said that there is now available a steam compressor by which the temperature and pressure of exhaust steam is raised to a degree which permits it to be transmitted through pipe lines.

Diesel Mechanical Maintenance*

Committee report covering repair and inspection practices with respect to Diesel engines, auxiliaries and steam generators emphasizes the precision with which the servicing and repair work on Diesel locomotives must be done both as regards the character of the work and the time intervals involved

With the introduction of the Diesel-electric locomotive a fundamental fact that is stressed by the builder is the high availability of that type of power. In a great many cases this has been translated to mean that only a slight amount of work is necessary to maintain the equipment. The work required to maintain the Diesel engine is exacting and must be done at regular intervals. If not handled accurately it will contribute to high maintenance cost and low availability.

In switching service, where the locomotive is used less than 24 hours a day, the inspection of engines will, of course, be determined by the amount of out-of-service time each day, and a maintenance schedule should be set up whereby all the work to be done on the engine may be handled during idle time, progressively. On locomotives working on a 24-hour assignment, it is necessary that the cycle of routine maintenance be laid out in such a manner that will permit the greatest amount of availability and the least amount of out-of-service time. This may be accomplished as follows:

1—A daily inspection that will not exceed the amount of time involved in the lunch period of the crew.
2—A weekly inspection that will not exceed the amount of time necessary to fuel the locomotive.
3—A monthly inspection that will not require taking the locomotive out of service more than one eight-hour shift a month for maintenance.
4—A quarterly inspection that should not exceed an eight-hour inspection.
5—A semi-annual inspection that should not exceed an eight-hour inspection.
6—An annual inspection that should not exceed a 24-hour inspection.
7—A two-year inspection at which time heavy engine work is done. It will be necessary to take the locomotive out of service for 72 hours in order to accomplish all the work.

On the Santa Fe railroad for example, in that class of service, the following is general practice:

*From a report presented at the September, 1948, meeting of the Locomotive Maintenance Officers' Association.

The daily inspection should cover visually the general working parts of the locomotive, including a check of the engine cooling water and lubricating oil supply, the quantity of water treatment carried in the cooling water, audible pounds that may be in the engine due to mechanical defects, condition of the air filters, cleanliness of the equipment particularly the engineroom, operation of the fuel system. Particular attention must be given to fuel and lubricating oil leaks in that they create a fire hazard. This daily inspection should not require more than a few minutes of an experienced man's time to satisfy himself that the engine is operating normally and satisfactory. Anyone familiar with Diesel engine operation should be qualified to handle this work.

After each week of service, the viscosity of the lubricating oil should be checked. If dilution exists, the cause should be determined and corrected. In normal yard work, the engine air filters should be changed after about one week's use.

At the monthly inspection, the engine crankcase cover should be removed immediately after the engine is shut down and the crankcase inspected for excessive gases. If the crankcase contains more than the normal amount of fumes, further inspection should be conducted to determine if a cylinder, hot bearing, or improper scavenging of the crankcase is bringing about this condition. It should be definitely located and corrected. A visual inspection of the engine should be made at this time, inspecting pistons, liners, crankcase, oil lines in the crankcase, and timing gears. The cylinder head mechanism should be inspected with the engine idling. The engine speed should also be checked both at idle and full throttle position. Any defective conditions located should, of course, be corrected.

After three months of service, the injectors or fuel pump timing and rack setting should be checked. Air pressure should be applied to each cylinder individually with cylinders spotted on top center of the compression stroke to check for a blowby condition that might indicate poor rings or a defective assembly. On some types of engines this is not necessary as it is possible to accomplish the same results by turning over the engine with the starter with crankcase covers removed. This will indicate excessive blowby. In this manner, a defective condition can be located and then corrected.

At the annual inspection, a more thorough inspection should be made. The overhead and rocker arm assemblies should be gone over to see that the lash adjusters are properly set on the rocker arm assembly, lubricating oil and fuel lines checked for leaks, crankcase covers removed and all liners inspected for scuffing condition. The intake and exhaust valve timing should be checked on four-cycle engines to see that the events are taking place at the proper intervals. On two-cycle engines, the events should be checked on the exhaust valves. A careful check should be made of the timing gears and gear train on the end of the engine, and if any difficulty has been experienced with main or connecting rod bearings they should be removed and inspected.

Experience has indicated that two years of service is the longest time that we permit main bearings to run before being removed and inspected. Connecting rod bearings are removed and inspected, as well as cylinder heads, pistons and liners. Injectors or fuel nozzles are removed and tested to determine if they are functioning properly.

On the Santa Fe, the lubricating oil changes are determined by the condition of the oil and the lubricating oil system.

After each week's service or at the weekly inspection, a viscosity test is made of the lubricating oil for dilution using a visgauge. A blotter test has also been inaugurated using a special white blotter for this purpose, and with the engine running or immediately after it is shut down, a drop of oil is removed from the crankcase and deposited on the blotter. If the color shown is other than the normal color of the oil (dark blots in the center of the oil deposit), it is an indication that the lubricating oil is not being properly filtered due to dirty filters, an excessive blowby in an assembly, or various other reasons. The blotter test will determine the amount of carbon content that is existent in the lubricating oil.

A record is maintained on the blotter indicating: (1) The date that the oil sample is taken; (2) The total mileage of the lube oil at that time; (3) The viscosity of the oil at that time; (4) The date that the filters were last changed; (5) Hours operated since last filter change out.

This record generally indicates the presence of dirty oil and what the difficulty might be. However, particular attention must be given to a dirty condition that may exist and the condition eliminated if the oil is to be continued in service.

It is also necessary at this time to make a visual inspection of the engine for the presence of water, metal, or other contamination. In the event any of these are present, it is necessary that the cause of that condition be eliminated.

At the time of the quarterly inspection, a one-quart sample of lubricating oil is furnished to the engineer of tests for his analysis. Lubricating oil which has been diluted to the condemning limit or has been contaminated with water, metal or excessive carbon should be changed. When the lubricating oil system accumulates sludge, the lubricating oil should be changed out in order to clean out the engine. When this is necessary, a good flushing oil should be used in the engine and the engine completely back-flushed. The lubricating oil screens should be cleaned and the filter elements changed and new oil applied.

It is essential that the progressive schedule of maintenance be set up so that engine work is completely covered by the time of the two year inspection. If the engines are maintained properly on this basis, it should not be necessary to do heavy crankshaft or frame work up until the time that the normal wear of the shaft becomes excessive. Experience indicates that this should be somewhat in excess of ten years of service.

In the maintenance of Diesel engines in road service, the determining factor in the cycle governing routine maintenance schedules is the class of service in which the power is employed and the terrain over which it operates.

In high-speed transcontinental service, the load factor is considerably less than in freight service in level grade territories. The same is true between freight work in heavy grade territory and freight work in level territory. In each case, it is necessary to set up specific maintenance schedules covering each assignment of power which can only be determined by those familiar with the amount of work each particular type of service requires.

The background Santa Fe experience indicates that the amount of fuel consumed per engine hour or per mile is a substantial basis on which this might be determined. It may be translated into miles, days, or any manner suitable to the operation after that basis is established.

Maintenance schedules are set up on engines in freight service in grade territory as follows:

1—After each trip or day's work.
2—At approximately each 3,500 miles, which is representative of about ten days service.
3—At approximately 10,000 miles, which would approximate a monthly inspection.
4—At approximately 30,000 miles, or a quarterly inspection.
5—At approximately 60,000 miles, or a semi-annual inspection.
6—At approximately 120,000 miles, or an annual inspection.
7—At approximately 240,000 miles, or a two-year inspection.

In the case of the same freight locomotive operating in level or rolling terrain, not considered heavy grade territory, the cycle of maintenance will be the same but the periods of inspection will be extended. In passenger service, the cycle of maintenance will remain the same and the time element further extended, with the exception in both cases of the inspection after each trip or day's work.

The builder in all cases specifies a particular amount of maintenance either on a mileage or time basis. This schedule is usually based on generalities and does not apply to any specific assignment so that it is entirely up to the user to specify the time element involved in the cycle of work to be done on the engine.

After each trip or day's work, the cooling system should be checked to determine if the proper quantity of water is in the system and if the proper amount of treatment is contained therein. The lubricating oil should be checked as to viscosity, dirt, carbon content, and quantity necessary for the engine. An inspection should also be made of the lubricating oil to detect the presence of water, metal, or other contaminations, and the cause should be corrected. The blotter test is made at this time.

At approximately 3,500 miles, or each ten days, the crankcase covers should be removed and the pistons, liners, and interior of the crankcase should be inspected. The air filters normally should be changed out about this time, however, the

amount of dirt involved in the operation should determine the cycle of filter changes. The lubricating oil filter change occurs at approximately this interval on our locomotives in that service. All cylinder assemblies applied since the last inspection should be inspected for defects. The heads and liners are tightened. The injector or fuel pump and the rack setting are checked. The connecting rod bolts are checked for tightness and wear. The general appearance of the bearing is inspected to see that it is operating normally and there is no scuffing or excessive wear indicated. An inspection of the cylinder head mechanism should be made with the engine idling, any noises noted, and further inspection made to determine cause of any excessive noises due to lash adjusters or rocker arm defects. On two-cycle engines that use the open port for scavenging air, an inspection of the rings and liners should be made through these ports. On engines other than those, careful inspection should be made in the liners to observe scuffing conditions indicative of ring breakage. Oil leaks in either the fuel or lubricating oil system should be eliminated. Any engine exhaust leaks should be detected and corrected.

At approximately 10,000 miles, or monthly, the engine speed should be checked both at idle and at full throttle. The operation of the overspeed trip should be checked to see that it is functioning normally and that the setting is correct. Crankcase breathers or lube oil system vents should be inspected to see that they are open. Where possible, the compression clearance of all cylinder assemblies should be checked to see that it does not exceed the minimum or maximum clearance. The fuel system should be inspected carefully and any filters that are dirty in that system should be changed out. The cycle of this inspection is determined, of course, by the quality of the fuel that is being used. On some types of engines, it is necessary to wipe out the air box at this time.

At approximately 30,000 miles, or quarterly, all heads and liners should be tightened or inspected for tightness, using a wrench on each nut. Rocker arm clearances should be checked and leveled up.

At approximately 60,000 miles, or semi-annually, the crankshaft end thrust should be checked and maintained within the maximum and minimum limits. The engine itself should be gone over at this time and tightened to eliminate oil leaks. The fuel pump or injector racks, linkage, and bell cranks should be checked over completely and any excessive wear should be taken up and they should be reset. The safety devices on the engine such as the overspeed trip, the low oil pressure controls, and the high temperature switches should be checked for accuracy and any adjustments necessary should be accomplished.

At approximately 120,000 miles, or annually, remove and inspect the main crankshaft and connecting rod bearings. Particular attention should be paid to the bearing caps to see that no cracks exist, which may be determined with a black light or by the magnafluxing process. The lubricating oil coolers should be removed and cleaned and reapplied. All copper pipe lines to gauges and other appertenances should be removed and knealed. The engine is load tested at full load for a minimum of one hour after all engine repairs have been completed, checking for speeds in all running positions. Careful inspection should be made for water or oil leaks in the engine. The load setting of the engine should be carefully calibrated and adjusted. All cylinder head mechanisms should be given a complete inspection and repaired, if necessary. Temperature of the lubricating oil should be checked after it has passed through the cooler to determine whether or not the functioning of the cooler is correct.

At approximately 240,000 miles, or each two years, a careful inspection should be made of the engine timing gear train, inspecting the gears, bushings, stub shaft and oil lines. On the accessory end of all engines, the accessory drive gear should be inspected and where harmonic balancers are used all springs in that balancer should be removed and inspected and safety dowels applied to that assembly. On engines using a mechanical type blower, the blower should be removed and new oil seals applied and bearings checked and renewed, if necessary. The lube oil pumps should be removed and checked as to capacity and bearings or gears renewed that might indicate excessive year.

Maintenance of Auxiliaries and Drives

The auxiliaries and auxiliary drives have always presented problems in the maintenance of the Diesel-electric locomotive.

On some original Diesel switchers, the air compressors, traction motor blowers and cooling fans were motor driven. This method was quickly abandoned, however, and the combination of V belts using drive sheaves, angle drives and jackshafts connected to the main engine was adopted.

On the first passenger Diesel-electric locomotives, an auxiliary power plant was used to drive the auxiliaries and traction motor blowers. The engine cooling fans were driven by V belts and sheaves connected directly to the main engine. This type of auxiliary drive was abandoned and auxiliaries connected to the main engine by the use of jackshafts, V belts and angle drives. This combination was continued until about 1947 when the locomotive builders introduced directly connected a.c. and d.c. motors for blowers and fans with the auxiliary generator connected directly to the main engine by a flexible coupling and gear drive, the air compressor being connected to the main engine by flexible coupling and jackshafts.

Where V belts, jackshafts and angle drives are used as connectors, a periodic and routine maintenance covers the inspection and repair on a progressive basis determined by the cycle of inspection and repair of the main engine depending on the type or class of service performed by the locomotive.

In road freight service, a maintenance schedule for the main engine has been set up and covers inspection and repair of auxiliary connectors. Daily or at the end of each trip, the lubricating oil supply in the speed increaser should be checked and oil added if necessary. Make visual inspection for oil leaks around speed increaser and check for any unusual pounds in the vertical drive or jackshafts.

At approximately 3,500 miles, or after ten days of service, check traction motor blower speed with a suitable hand tachometer. Check tension of traction motor blower, auxiliary generator and cooling fan belts, paying particular attention to any raveling or cracking of the belts. Engage fan clutch and observe upper and lower fan bearings with engine running.

At approximately 10,000 miles of service, or monthly, grease cooling fan and cooling fan idler bearings. Grease throwout bearing on fan clutches and traction motor blower bearings. Check operation of fan clutch and adjust if necessary. Oil fan clutch pins and rollers using small amount of lubricating oil.

At approximately 60,000 miles of service, or semi-annually, make visual inspection of drive clutch plates and its operation. Grease air compressor flexible coupling drive. Drain oil out of speed increaser, clean interior of any sludge, dirt or other contamination. Observe general condition of gears and bearings, check oil lines and refill with lubricating oil.

At the time of annual inspection, dismantle the air compressor flex couplings. Clean and inspect for wear or cracks, renew seals, lapping in the cover and hand pack with grease.

On Diesel switchers, working in 24-hour yard service, a maintenance cycle other than the daily inspection must be set up to perform the necessary routine inspection and repair to the auxiliary drives that will permit the greatest possible availability of the locomotive. This cycle is determined by the inspection periods of the main engine.

On the Santa Fe Railroad, for example, the general practice is as follows:

Daily inspection should cover visually the operation of the cooling fan assembly and fan clutch operation if used, observing any oil leaks or unusual knocks in the cooling fan drive shaft assembly.

At the time of monthly inspection, check the tension of all V belts and observe their general condition for breaking or raveling. Grease traction motor and cooling fan and idler sheave bearings. Where angle drives are used, add grease or lubricating oil to gear box as needed.

After three months of service, lubricate air compressor drive coupling, if used.

At the semi-annual inspection, remove cover and inspect air compressor flex coupling.

At the annual inspection, drain gear box oil on locomotives

using angle drives. Clean and refill with lubricating oil. Check cooling fans and all drive shaft and housing assemblies for cracks and tighten all bolts.

The maintenance of the auxiliary drives on both road and switch locomotives has been set up to cover a progressive cycle of maintenance over a one year period. If the maintenance is performed properly, it should not be necessary to renew or make heavy repairs to the drives.

The maintenance and repair of auxiliaries will, of course, follow the cycle of progressive maintenance set up for the main engine. This maintenance schedule may be laid out for the various auxiliaries as follows on road locomotives:

Maintenance Schedule for Auxiliaries

Air Compressor—At the daily inspection or end of each trip, check operation of the air compressor governor, drain condensation out of the intercoolers, and observe general condition of the air compressor for oil leaks or any unusual pounds. Check crankcase oil supply and with engine running note air compressor lubricating oil pressure.

At the monthly inspection, drain the intake air filter sump.

At the quarterly inspection, renew the unloader diaphragms, drain crankcase oil and inspect crankcase for any defective conditions or sloughing of bearing metal. Any defects found should, of course, be corrected. Using kerosene and wiping towels, clean interior of the crankcase and refill with lubricating oil. Apply orifice test to the air compressor as per government specifications.

At the annual inspection, remove air compressor valves and unloaders for reconditioning and reapply. Clean, inspect and adjust air compressor governor. Check alignment of air compressor relative to main generator.

Each two years at the time of annual inspection, perform complete overhaul of the air compressor. This consists of removing cylinder heads, pistons and rods, cylinders and main crankshaft. Inspect main bearings, check cylinders for wear and recondition all parts and reassemble.

The above progressive maintenance schedule covers the inspection and maintenance cycle for two years, including heavy repairs. If the inspections and maintenance are rigidly followed, the air compressor will be kept in such mechanical condition that it will deliver its proper volume of air at all times.

Traction Motor Blowers—Daily observe any unusual pounds or knocks. Check fan shaft bearing temperature.

Monthly, inspect the traction motor blower bellows and add grease to the fan shaft bearings.

Quarterly, inspect fan blades and clean if necessary.

Cooling Fans—At approximately 3,500 miles, or each ten days, inspect fan wheels on top of roof for loose or cracked blades with the engine stopped. This cycle of inspection is determined by the construction of the fan itself as service has proven the solid cast fan of lighter metals to be far superior to the fabricated fan. Lack of strict inspection of the fan blades on the early types has resulted in considerable repair and expense due to damaged radiator sections.

Engine Governor—The engine governor is a vital mechanism responsible for the function and control of the main engine. It also maintains smooth coordination between the Diesel engine and the main generator under varying load conditions. Once properly set, the governor requires little attention mechanically. However, it is sensitive to a proper supply of lubricating oil, and must be kept free of sludge. Only clean oil should be added when necessary to replenish the oil supply within the governor.

Daily or after each trip, the oil supply should be checked and the level maintained as prescribed. Make visual inspection for oil leaks or unusual conditions.

After 10,000 miles, or monthly, check engine speeds in all sequences, overspeed trip setting, engine loading and power piston setting, and grease governor linkage.

After 60,000 miles, or semi-annually, drain, flush and refill with lubricating oil. On governors incorporating low lubricating oil switches and shut-down devices, it will be necessary to check the pressure settings and function of the shut-down feature.

At approximately 240,000 miles, or each two years, dismantle, clean and service all parts. Renew any worn or defective parts, make necessary adjustment and reassemble.

Engine Scavenger Blower—On engines using mechanical type blowers, after each two years of service, the blower should be removed. Renew oil seals, inspect bearings and renew if defective.

Speed Recorder—After each trip, or daily, lubricate speed recorder drive cable.

After ten days service, or 3500 miles, lubricate the mechanism of the speed recorder using 15 drops of SAE-10 oil in worm gear housing oil cup and fill reversing gear chamber with SAE-10 oil.

At approximately 60,000 miles, or semi-annually, remove speed recorder, clean and calibrate. Remove speed recorder drive cable, clean cable, inspect for worn links, lubricate cable and reapply cable and speed recorder.

After two years of service, remove and make complete overhaul consisting of cleaning and servicing all parts, check gears, plungers, cylinders, etc. for wear, reassemble and calibrate.

The maintenance and inspection of auxiliaries on Diesel switchers operating in 24-hour switching service follows the same cycle of maintenance inspection and repair set up for the main engine and auxiliary drives.

Air Compressor—At the daily inspection performed during the lunch period of the engine crew, check operation of air compressor governor, drain condensation from intercoolers, check air compressor oil pressure and crankcase lubricating oil supply and replenish if necessary.

At the monthly inspection, remove and clean air intake filters.

After three months of service, apply orifice test as per I.C.C. specifications.

At the semi-annual inspection drain crankcase oil, inspect interior of crankcase for sloughing of bearing metal, observing connecting rods and bearings. Using kerosene and wiping towels, clean interior of crankcase and refill with lubricating oil.

At the annual inspection, a thorough inspection should be made of the air compressor removing and reconditioning valves and unloaders and renewing unloader diaphragms.

After four years of service, the air compressor should be removed for a complete overhaul, removing cylinder heads, pistons, cylinders and crankshaft. All parts should be thoroughly cleaned and inspected. Check cylinder walls for scoring and wear, recondition all parts and reassemble.

Traction Motor Blower—The inspection and maintenance of traction motor blower fans do not require a great deal of attention other than the periodical greasing of the drive shaft bearings.

At the monthly inspection, check fan blades for cleanliness and clean if necessary. This inspection is determined by the climatic condition the locomotive is subjected to while in service.

Cooling Fan—At the monthly inspection, blow radiators and fan blades; check blades for cracks or other defects. On some of our first switchers, the fans were fabricated and we experienced considerable amount of breakage, often damaging the radiator sections. This has been practically eliminated by adopting a lighter solid cast fan which has better balance and less stress.

Engine Governor—Daily, observe the oil supply, add necessary amount of clean oil to bring oil level to proper level. Make visual inspection for oil leaks.

At the monthly inspection, check engine speed in all sequences and adjust if necessary. Governors incorporating low oil pressure switches and solenoid shut-down feature should be checked relative proper pressure settings and functions.

At the semi-annual inspection, the governor should be drained and filled with new engine lubricating oil.

At the annual inspection, the governor should be drained and flushed with a good grade of flushing oil and refilled with new lubricating oil.

Each two years, remove governor and dismantle, clean all parts and check plungers, valves and bushings for wear, renew worn parts, make necessary adjustments and reassemble.

Turbo Type Supercharger Blower—At the semi-annual inspection, remove turbo charger fan shaft bearings, clean and inspect for wear or pitting.

Each four years, remove turbocharger and perform com-

plete overhaul. This work is usually done on unit exchange basis. On locomotives using a mechanical type blower, after four years of service when blowers are removed for the gear train inspection, renew oil seals and inspect general condition of blower.

The inspection and repair of directly-connected auxiliary drives using direct current is generally as follows:

At the time of monthly inspection, motors should be blown and cleaned, checked for short or broken brushes, loose connections and condition of commutators, correcting all defective conditions.

At the annual inspection, a dielectric test should be applied and all exposed wiring painted with a good grade of insulating paint.

The above maintenance cycle has been used on the Santa Fe with good results. As we have few locomotives using this type of auxiliary drive, we are not in a position to set up a maintenance schedule determining the cycle of heavy repairs at this time.

The latest type of auxiliary drive introduced by one of the builders is the alternator using a three-phase induction motor directly connected to the traction motor blower and cooling fans. This type of drive eliminates all commutator brush holders and brush maintenance problems.

Steam Generator Maintenance

The forced circulation water-tube steam generating units using Diesel fuel oil with electric ignition were introduced with the Diesel-electric passenger locomotive. The first steam generator was the C-4200, having a rated capacity of 2,000 lb. per hour. This was followed by the CB-4225, with a rated capacity of 2,250 lb. per hour. The next steam generator to appear on the Diesel locomotive was the CFA-4225, which was later revised and known as the CFK-4225, having a rated capacity of 2,250 lb. per hour. This steam generator unit was improved from time to time by the application or removal of different accessories such as: removal of the float mechanism for control of the water level in the separator and application of stand pipe in separators and steam traps; removal of photo-electric eye control equipment and application of double-acting stack switches; application of remote control on soot blowers and separator blow-down valves and the application of steam temperature limit controls. This steam generator was followed by the DK type, which was later revised and known as the DRK, having a rated capacity of 3,000 lb. per hour. At the present time, steam generators known as OK and M-2 type are being used on Diesel locomotives with a rated capacity of 3,000 lb. per hour.

The evaporative capacity of the steam generator limits the number of cars that can be successfully heated in winter or cooled in summer with steam ejector type air conditioning equipment. In the same manner, the water tank capacity for the steam generator limits the distance that may be covered between watering stations. The space and weight requirements as to the size of steam generators and water tank capacity have been rigidly set up by the locomotive builders. The manufacturers of steam generators at the present time are trying to increase their evaporation capacity in the same given space, but even though this is successful, we still must have an increased water capacity available to be able to utilize any increase in steam generator capacity so that we can operate greater distances and longer trains.

The present trend in steam generator installation is to install two or more on the complete locomotive. In some cases, railroads have installed as high as two steam generators per unit. The most successful steam generator at the present time utilizes three sets of coiled water tubes connected in series to form a continuous tube several hundred feet in length. These coils have a forced circulation of water through them, with Diesel fuel oil being burned in the center of those coils under forced draft. The flow of heated gases through the coils converts the water into steam. At the present time, the top capacity of steam generators for Diesel locomotive use will evaporate from 3,400 to 3,600 lbs per hour.

To insure that there is sufficient steam capacity from the steam generator it is important that proper maintenance be given the equipment. Due to the fact that the steam generator is part of the locomotive, the maintenance schedule should be set up so that its inspection and repair can be handled at the same inspection periods as the rest of the locomotive. The items of the progressive schedule of maintenance should be set up similar to the Diesel locomotive in which we find that certain items need inspection oftener than others to prevent failures.

The maintenance schedule should include trip inspection (approximately 5,000 miles), monthly inspection, quarterly inspection, semi-annual and annual inspection. These schedules list various items which it has been necessary to examine and repair at certain periods of time to insure trouble free steam generator operation on the road. Also it will be noted that various items cover several different kinds of steam generators now in service.

The annual inspection items have been set up for complete overhauling of steam generators; removal and hammer test of coils to detect thin or burned spots; renewal of all brick work and complete inspection and overhaul of all electrical equipment. These items can easily be handled during annual inspection of the Diesel locomotive. With these items properly serviced it will do much to insure successful steam generator operation for another year.

On the Santa Fe, the following maintenance schedule has been set up based on experience with the various types of steam generators:

Trip Inspection

1—With a ½ inch orifice in trainline and steam generator operating for about five minutes at full capacity, CFK steam generators must maintain at least 150 lb. on trainline, DK steam generators at least 180 lb.
2—Check water pump packing for leakage.
3—Record water pressure and separator steam pressure.
4—Turn purolator handle several times.
5—Open water pump test valve. Fire should go out.
6—Check operation of remote control from both cabs.
7—Check steam trainline for leaks.
8—Check safety valve setting: CFK—245-250 lb.
DK—295-300 lb.
9—After firing, blow down the coils and refill with water until cool.
10—Check outfire relay by closing air to nozzle, place switch in run position. Motor should shut down in 45 seconds.
11—Check condition and level of oil in water pump.
12—Check water pump and blower bolts for condition and tightness.
13—Check spark plug setting and condition of leads.
14—Clean peep sight glass, remove any carbon from nozzle and stabilizing cone.
15—CFK—Note that all relays come in properly.
DK—Note servo comes to full fire position.
16—Free up remote control pilot valve.
17—Clean strainer in water treatment tank. Check the cover seal rings.
18—After steam generator has been tested out, clean strainers in separator return line.

Monthly Inspection

Mechanical

1—CFK—Clean manifold fuel filter.
DK—Clean fuel filter to servo.
Drain purolator filters.
2—Repack remote control pilot valve.
3—Examine boiler check valves, make necessary repairs.
4—Clean nozzle and examine packing and diaphragm.
5—Clean grooves in CFK water pump.
6—Drain and flush water tanks.
7—Inspect interior of boiler, make necessary repairs.

Electrical

1—Clean CFK pressure switch dash pot and add new oil.
Clean DK overload dash pot and add new oil.
2—Clean air solenoid valves.
3—Blow cabinets and motors.
4—Inspect for any defect.

Lubrication

1—Add small amount of grease to blower bearings.
2—Oil damper shaft bearings.

Quarterly Inspection

1—Safety valves must test: CFK—245-250 lb.
DK—295-300 lb.
2—Test steam gauge.
3—Repack steam temperature limit control.
4—Repack separator blow down valve.
5—Clean steam traps.
6—CFK—Remove inspection plate and clean soot from coils.
7—Check stack switch.
8—CFK—Oil moving parts of pressure switch.
9—Add small amount of grease to motors.

Semi-Annual Inspection

1—DK—Remove inspection plates and clean soot from coils.
2—Clean water portion of water by-pass regulator.
3—Renew fusible plug in high temperature switch CFK boiler.
4—Inspect and repair separator steam traps.
5—Overhaul all trainline flexible conduit and renew all gaskets.

Electrical

Blow dirt out of motors and clean. Examine commutators and slip rings for condition. Renew brushes that show more than half worn.

Annual Inspection

Mechanical

1—Apply hydrostatic test to steam generator 25 per cent above working pressure. This should be 313 lb. for CFK and 375 lb. for DK steam generators. (See item No. 12.)
2—Overhaul steam generator water pump unit.
3—Clean out water suction lines and all separator water return pipes between water tank and steam generator. Make necessary repairs. Clean all water lines on boiler.
4—Inspect and repair air cylinder on air operated separator blow down valve and lubricate. Take up wear in operating lever.
5—Renew all check valves.
6—Inspect and overhaul serve fuel control on DK steam generators and on CFK generators overhaul fuel control.
7—Inspect, test and repair remote control steam trainline shut off valve.
8—Clean steam generator blower fans and check fan for bearing wear, make necessary repairs.
9—Clean steam generator air inlet duct in roof.
10—Overhaul coil blow down valves.
11—Overhaul and replace diaphragm in pressure switch on CFK steam generator. On DK overhaul water by-pass regulator.
12—Remove all steam generator coils, inspect and recondition as follows:
a—Clean outside of steam generator coil and make thorough visual inspection for cracks, pitting, corrosion and overheating.
b—Hammer test all exposed surface of steam generator coil to determine weak spots in coil wall.
c—Wash scale out of interior of coil using 25 per cent solution of Oakite 32.
d—Make required repairs to coil as indicated by visual inspection and hammer test.
e—Apply hydrostatic pressure test of 1,200 lb. to coil after all repairs have been completed.
Note: Coils should be inspected and reconditioned in sequence as listed above.
13—Inspect, recondition fire pot and accessories as follows:
a—Examine fire pot and air ring for warped condition, renew if necessary.
b—Examine flame deflector, if spalled or otherwise damaged, new refractory brick should be applied.
c—If flame plate is warped or cracked it should be renewed.
14—Renew separator blow down line.

Electrical

1—Overhaul steam generator water pump motor and rotary converter.
2—Apply new helix to stack switch, and set to break electrical contacts at 900 deg. F.
3—Megger test insulation resistance of steam generator wiring, solenoid coils and ignition transformer. Make necessary repairs.
4—Check and repair terminals, wiring and plug receptacles of remote control equipment.
5—Test all control equipment for proper operation after repairs are completed.

Nothing has been given on the washing of the steam generator coils in the above maintenance instructions. The I.C.C. requires that the coils be washed once each month. Present Santa Fe practice is to wash the steam generator coils when the water pressure is 350 lb. or over with the generator operating at full capacity.

On some of the later passenger locomotives, a considerable amount of difficulty has been experienced in extreme cold weather. This has been due to the freezing of fill up lines, steam pressure control lines and steam gauge lines. Some of this trouble has been brought about in the design of the locomotive so more car body filters could be applied adjacent to the steam generator and the water tanks, also fill-up lines have been lengthened so that the water tanks could be placed inside the locomotive. The lack of heating arrangements around the generators and the water tanks have added to this condition. Some of the items in which difficulty has been experienced during freezing weather with suggested corrections are as follows:

Freezing of Water Fill-Up Door Covers, Check Valves and Fill Lines—To help eliminate this condition ¼ inch o.d. copper tubing from a live steam connection is run the length of the water tank fill-up lines on both sides of the unit and allowed to discharge into the water tank itself. These lines should be completely lagged which will hold the heat to the water fill-up line itself. The water fill-up line check valves should have a ⅜ inch pipe connected above and below the seat to properly drain them. To eliminate fill-up door cover freezing solid they may be notched on both sides or 1/16 inch more clearance be given at the bottom to allow this door compartment to properly drain.

Freezing of the Steam Gauges on Steam Generator—These should be properly lagged which will help eliminate freezing.

Freezing of Water By-Pass Control Steam Side and Freezing of Coils and Water Pump When Steam Generator Is Not Operating—This can be eliminated by the application of a metal shroud which will completely enclose the water pump, water by-pass control and its related pipe. By the addition of a steam heating coil beneath the water pump for heating and a steam heat line for reverse flow of steam from trainline through the coils, it should be possible to safely leave the steam generator shut down in sub-zero temperatures.

Freezing Up Steam Trainline and End Valve at Front of Locomotive—In many cases the steam line end valve is cracked to bleed a small amount of steam to keep the trainline from freezing, but this procedure is a nuisance to engine crews due to steam coming up the sides of the locomotive. The most successful solution to this problem is the application of a small steam trap directly behind the end valve beneath the pilot.

Some of the other difficulties experienced on steam generators are as follows:

Safety Valve—The present brass safety valves have been a source of trouble due to leakage and erratic pop settings, due to weakened springs. A heavier duty steel safety valve appears to be the logical answer to this complaint. At the present time there are several makes of steel safety valves on test.

Steam Generator Coil Life—The life of the coils is determined by the condition of the water used and the service in which the steam generator is operating. To prolong the coil life in the present type steam generators, it is important that the fuel be adjusted so that not more than 95 per cent of the water will be evaporated. This will keep the coils from scaling and overheating thereby prolonging their life. It might be possible due to special grades of steel tubing to expect greater coil life in the future.

Cab Controlled Remote Trainline Shut Off Valve—This has been a continual source of trouble. The present shut off valve has not been satisfactory and on long runs cannot be made to operate at all. Tests are now being made on motorized stop valves and to date no information is available.

Steam Generator Water Transfer Line Between Units—At the present time, water tank transfer lines between units are located too high above the bottom of water tanks, causing a condition where 400 or 500 gallons of water cannot be used for the steam generator. These lines are not insulated and are subject to freezing at sub-zero temperatures.

Spark Ignition Cables—The present type of ignition cables for spark plug electrodes are made of ordinary high voltage cables. They are subject to extreme temperatures at various times and catch on fire. We should have a high voltage asbestos cable for this purpose.

Bad Water Conditions—In a number of places on various railroads, water for steam generator use is very high in scale forming proportions. There are numerous water treatments on the market today but it appears that the most logical move is to treat water off the locomotive at wayside plants. Water treatment applied on the locomotive merely adds to the sludge that we are trying to eliminate.

Breakage of Fire Pot Refractories—A certain amount of trouble is experienced with fire pot refractories cracking and breaking up in steam generators. This is due to not being able to allow sufficient time for them to set up after being applied. It would be well if a plastic fire brick refractory could be developed that would set quicker and withstand greater temperatures.

Breaking of Copper Pipes and Flares Due to Vibration—Breakage of copper pipe and pipe flares is also a constant source of trouble. This is brought about in many instances by improper clamping and the use of thin-wall tubing. This can be eliminated to a certain extent by the use of flexible metal or plastic tubing. Heavy wall copper tubing and better type of tubing connectors will also help eliminate this breakage.

The members of the committee were: H. F. Mackey, supervisor of Diesel engines, Atchison, Topeka & Santa Fe (Chairman); T. T. Blickle, master mechanic, Atchison, Topeka & Santa Fe (vice-chairman); F. Thomas, assistant to general superintendent motive power, New York Central System; R. W. Murray, general supervisor of Diesels, Seaboard; H. D. Parker, general Diesel supervisor, Atlantic Coast Line; J. W. Whipple, Jr., superintendent Diesel equipment, Denver & Rio Grande Western; K. M. Darling, engineer Diesel equipment, New York, New Haven & Hartford; R. W. Seniff, engineer of tests, Gulf, Mobile & Ohio and W. A. Hotzfield, supervisor Diesel service, Chicago, Milwaukee, St. Paul & Pacific.

Discussion

K. M. Darling (New Haven) discussed the maintenance practices in effect on his road and raised a question as to load testing Diesel engines after annual inspection, or where there is an engine overhaul without removing the engine from the locomotive. He described the New Haven's practice of load testing and raised the question for discussion, "Should we take the time to load test an engine or put it to work out on the road immediately?"

C. D. Cotten (Birmingham Southern) in a discussion submitted on the question of relating maintenance to fuel consumption mentioned that the actual hourly consumption of a 1,000 switcher may vary from 6 to 20 gal. and that because of that wide variation many maintenance operations, such as pulling pistons, for example, should be based not on engine hours but upon a fuel consumption basis. He mentioned that, as an experiment, "we set up a total of 160,000 gallons of fuel as the basis of pulling pistons on 660 hp. switchers. One locomotive had worked 22,757 engine hours when taken out of service; the other had worked 27,600 hours." The establishment of a fuel consumption basis of maintenance, he said, must depend upon such factors as liner and piston condition for where these parts were new, the 160,000-gallon basis seemed to be all right but was too long a period if liners are used the second time. On one engine, for example, after 14,000 hours pistons and liners were o.k. to continue in service but on the second pulling the top rings were found broken on most pistons. These, he mentioned, were aluminum alloy pistons and went on to mention service periods of 36,750 hours and 41,600 hours without unusual difficulties. He mentioned that after having established the 160,000-gal. basis for 1,000 hp. switcher engines it was later deemed advisable, as a result of experience, to reduce the service period to a 120,000-gal. (fuel) basis. In concluding he said, in part, the idea is that the fuel consumption represents heat input and if it were practical to convert this to B.T.U. input we would still have a better yardstick. The rate of work done definitely affects engine wear and some day we hope to work out a suitable relationship between average gallons of fuel per hour and the total amount of fuel burned. We may find that for a certain type of engine 120,000 gal. of fuel burned at the rate of 5 to 6 gal. per hour is all right but if the average consumption goes to 6 to 10 gal. per hour we may have to introduce a factor based on the average consumption per engine-hour that would reduce the total amount of fuel burned.

For example, he said, one locomotive might average 6 gal. per hr., another 10 and another 15 gal. Taking 120,000 gal. as the basis the first locomotive would go 20,000 hours between overhauls; the second 10,800 hours and the third 6,400 hours, with factors of 1.0, 0.9 and 0.8 used in each of the three cases, respectively, as compensating factors for the rate of work done. This factor serves to reduce the number of gallons between overhauls as the fuel rate per hour engine increases.

In concluding, Mr. Cotten said, "If a yardstick could be worked out, using fuel consumption, as a basis, I believe we would be much closer to determining the economical overhaul period than we now are, and would be able to compare notes on each other's experiences much better. If a fuel consumption basis were used, it is entirely possible that the road that pulls pistons every year and the road that does it every 30,000 hours are both right, but unfortunately this is not the case.

"On switcher locomotives such a plan is feasible. I am not in a position to know whether or not it can be done in the case of road locomotives, but evidently it can."

J. E. Justus (Fairbanks-Morse) put in a word for a better yardstick for planning maintenance programs that would reduce the cost to the railroad and give manufacturers something more definite upon which to make recommendations to the users. The present use of miles or hours, he said, is such a "rubbery" yardstick that it is expensive, and he suggested consideration for the adoption of the fuel consumption basis mentioned by Mr. Cotten.

A member asked what factor should govern the removal of the engine from the locomotive and commented that he did not think many railroads were doing it on a mileage basis. Mr. Mackey said that on the Santa Fe engines are removed only when crankshaft or crank difficulties have been experienced and that normal shaft wear has not yet been sufficient to establish a definite basis.

W. N. Boyd (Port Huron & Detroit) discussed the problem of flange wear and described a device developed on that road for applying liquid graphite in small quantities at positive intervals which has shown excellent reduction in flange wear, on that road, and "practically eliminated derailments with our Diesels" as well as increasing brake shoe life due to the impregnation of the flange way of the shoe with graphite. He mentioned this development with the idea that it might be helpful to other roads operating Diesel switchers in similar service.

A member raised a question as to methods of determining the amount of dilution by water leakage; whether by laboratory analysis or otherwise. Mr. Mackey commented on this and said that one way to determine the amount of water in the oil was to open the drain valves to the sump every trip and that another way to indicate water leakage into crank cases was to require reports from engine crews of any lowering of water in the sight glass or of the necessity of taking more water for cooling purposes en route. They found, he said, that when the program was inaugurated 60 per cent of the locomotives were taking water and that after certain head gasket conditions were discovered and remedied water loss was reduced to a normal minimum.

Front Ends—Grates—Ash Pans*

A review of the reports of past years shows that many promising developments, particularly in front-end arrangements, have not proved satisfactory and have been discarded or faded into obscurity because other considerations such as cost of installation, increased cost of maintenance, and the necessity for dependable service have offset the improved performance obtained with the new design or arrangement.

Eliminating Plugged Netting

The Santa Fe uses a nettingless front end consisting of a large box resting on the exhaust-nozzle stand with the front side of the box open to the flow of gases and cinders with angular shaped baffles in the back of this box, provided for the purpose of breaking up the cinders by impingement at high velocity, thus eliminating the expulsion of sparks from the stacks and preventing the setting of fires. This type of front end, however, is not self-cleaning and the committee has nothing to report on its efficacy with regard to throwing of fire or its efficiency in the production of draft. It does eliminate stopped up netting. The front ends of all the other railroads investigated were, in principles, that of the so-called Master Mechanic's front end and were using netting to prevent the throwing of sparks that might result in setting of fires.

The committee reviews past reports and finds data on front-end improvements ten or more years old of which very little use has been made. Growing interest in the Diesel appears to be trending toward neglect of the care and maintenance of steam locomotives with a definite waste of fuel.

One railroad, the Great Northern, uses a perforated plate with enlongated holes 3/16 in. by ¾ in. The unusual feature of this front end, other than the type of exhaust nozzle and stack, is that this perforated plate is installed with elongated holes horizontally instead of vertically, the generally accepted practice. The netting does not stop up as readily as netting with square holes or netting with enlongated holes placed vertically; in fact, no trouble of this sort has been experienced. Very satisfactory results have been obtained by the installation on several Santa Fe locomotives using a high-volatile soft coal of Draftac netting in the front end having holes placed horizontally instead of vertically. After five months' service, none of the locomotives so equipped has experienced any trouble with stopped up nettings.

Draft Efficiency

In the discussion on front ends last year by members of the Association, emphasis was placed on the desirability of the use of nettingless front ends. The report on this subject in 1934 referred to the use of the Cyclone front end, built with no netting, but with a series of baffles in a circular-shaped box installed between the nozzle stand and the extension stack, so that when the locomotive is in operation, a centrifugal action of gases and sparks is developed by the use of deflectors which causes the sparks to be whirled about violently. Reports state that the exhaust-nozzle tips were opened about 15 per cent with a reduction in back pressure amounting to as much as 25 to 40 per cent and that the throwing of sparks and setting of fires was practically eliminated. It was also stated that the maintenance of the front end was much less than that of front ends with netting and that 65,000 miles were made without expending anything for maintenance.

It should be noted that following the front-end test made at the University of Illinois and reported in 1933 and again in 1934, a test was made of the Cyclone front end with a report that it gave excellent performance in the production of draft and a confirmation of its performance reported on the Northern Pacific.

The test and experimental work carried on by the University of Illinois, on which published reports were made and distributed, were of great importance in the information and guidance furnished to designers of locomotive front ends. But there is some question whether the value of this information has been fully appreciated. Changes in accepted standards and adopted practices are often most difficult to bring about.

In the Illinois University tests, more than three hundred different combinations of front-end arrangements were constructed and tested with no more than 12 per cent improvement in air flow produced in comparison with the plain circular exhaust nozzle. The most efficient type of exhaust nozzle tested was the four ported or pepper box type. By efficiency is meant the production of draft with the least back pressure. The four-ported Layden exhaust nozzle has been used and adopted on all classes of locomotives on the Santa Fe giving very satisfactory results for many years.

Maintain Front Ends

In concluding paragraph of this report for last year is the following statement: "Because of the trend toward Dieselization on many roads, the possibility of improved appliances on the conventional steam locomotives will, no doubt, receive less consideration from responsible officials in the years to come." Today, more than ever, there is substantial evidence of the

The "Dutch oven" through which the burning oil passes into the firebox

* From a report presented at the September, 1948, annual meeting of the Railway Fuel and Traveling Engineers' Association.

truth of the above statement. With this in mind, more emphasis should be placed on the importance of proper maintenance of front-end arrangements and devices than in experimenting in the development of new and untried devices.

All steam locomotives are equipped with front-end arrangements which, if properly maintained, will produce sufficient draft to insure good steaming, providing, of course, the locomotives are properly operated, are in reasonably good mechanical condition, and a suitable fuel is provided. When these conditions are not met, there will certainly be an increase in the fuel performance of locomotives.

Recently on a certain division, because of an increase in the fuel performance and a realization that conditions were not what they should be, an investigation was made which showed that more than 50 per cent of the main class of freight locomotives were reported not steaming during the month, with reports varying from eight to eighteen per individual locomotive. Superheater units were leaking, there were excessive air leaks around front ends, flues were stopped up with cinders and flue sheets honeycombed. The quality of fuel was not good, containing excessive fines, with excessive moisture in the fuel due to weather conditions. Locomotives were wasting fuel on account of cylinder and valve packing and, to some extent, inexperienced firemen firing the locomotives. When drastic action was taken against these familiar causes, there was a definite improvement in the performance of the locomotives on this division.

When locomotives are reported not steaming, the practices, in effect on some roads, should be followed of putting a water pressure test on superheater units, steam pipes and exhaust-nozzle stands, check front end arrangement, for defects, and all defects which contribute to steam failures in which the condition of the cylinder and valve packing is of considerable importance. It is recommended that a definite rule of making these tests on each monthly inspection should be followed.

Grates, Arches

Many roads have obtained more satisfactory results with air openings 10 per cent to 12 per cent of the total grate area, while supervisors of locomotive performance twenty to thirty years ago considered air openings less than 35 per cent to be impossible of efficient performance. Most roads consider that the minimum air opening is more effective, as it is desirable to maintain a thin level fire with stoker operation to produce efficient combustion with good steaming, but this cannot be attained with large air openings. Efficient combustion depends upon many factors and may be accomplished by various types of grates. Most roads are using the type of grates best suited to the quality of coal used and, after many years of experience, are using the type of grates most suited to their conditions. The round-hole table grates with holes ½ in. in diameter, or slightly greater, with air openings approximately 10 per cent to 15 per cent, are favored and in general use on some of the larger railroads, while others are using the Tuyere type of the Hulson Company, and other roads use the Firebar unit type grate, each of which has given years of satisfactory service.

Brick arches must be properly maintained to aid in the production of efficient combustion and good steaming. Holes in a brick arch tend to produce more cinders through the flues and, consequently, increase the fire hazard. A brick arch sealed tight at the flue sheet is definitely recommended.

Maintenance forces claim that a brick arch set away from the flue sheet about 5½ in. eliminates a heavy accumulation of cinders and ash on top of the arch and is more desirable from the standpoint of maintenance, but for the purpose for which the arch is provided, this arrangement is not recommended.

Dutch Oven for Oil Burners

Brick arches on oil-burning locomotives have not shown any economical advantage, but have shown definite maintenance disadvantages which have, until recently, prevented any development in this line. However, in the past two years there has been a rather rapid development on several roads of the use of what is known as the "Dutch Oven" in oil-burning locomotives, with advantages claimed in better steaming and higher firebox temperatures, resulting in more efficient combustion.

The Santa Fe has equipped many locomotives of different classes with the Dutch Oven, and with locomotives so equipped have opened up exhaust nozzles ¼ in., with locomotives steaming better than formerly. On some classes, the maintenance problem has not been satisfactorily solved, and a suitable design of brickwork for this purpose has not been found acceptable, but there has been enough evidence of better performance to insure further development on this road.

One requirement when the Dutch Oven has been applied has been the strengthening of the fire pan by the use of braces and carrier supports to prevent vibration and shaking down of the Dutch Oven in less time than has been experienced with the standard arrangement.

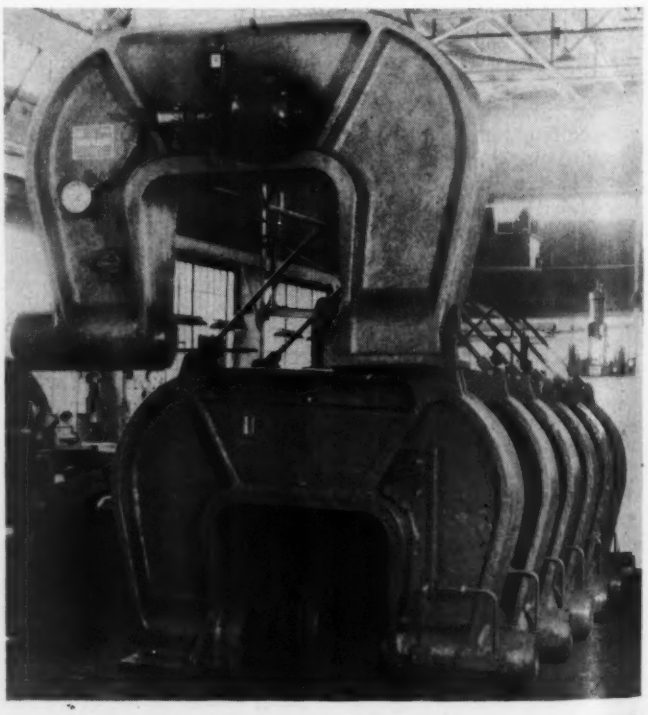
This report was prepared by a committee of which S. R. Tilbury, fuel supervisor, Atchison Topeka & Santa Fe, was chairman.

Discussion

Most of the discussion on this report dealt with the Dutch oven installation in oil-burning steam-locomotive draft pans. Some of the troubles have been due to the use of improper brick or a lack of a sufficiently rigid oven structure to withstand the shocks and vibration of locomotive service. It was reported that on the Texas & Pacific after about 350 miles of service of locomotives equipped with Dutch ovens it is necessary to clean carbon off the oil burners. The chairman of the committee reported that this trouble had been eliminated by setting the burner entirely outside of the fire pan, thus keeping it cool. One of the advantages of the Dutch oven mentioned in the report which was confirmed by experience on at least one other road is the effect it has in keeping the locomotive hot while drifting. This was reported particularly in the case of its application to a class of locomotives with shallow fireboxes. One of the early disadvantages of the Dutch oven was the need for stronger atomization with resulting objectionable noise. Shortening the Dutch oven was reported to have effected improvement in this respect.

Comment on the use of a perforated plate with the slots horizontal in the front ends of coal-burning locomotives indicated that where this has been tried the stopping up of the netting has been eliminated.

* * *



Seven portable hydraulic presses of 200 metric tons capacity, for pressing in crank-pins, made by Watson-Stillman for European railroad shop practice. An overhead crane brings the portable forcing equipment to the driving-wheel sets rather than taking them to stationary forcing presses for assembly and disassembly as is customary in this country.

EDITORIALS

Miles—Or Gallons?

In a discussion of the question of the proper relationship of the service which a Diesel engine should be expected to give up to the period at which overhaul should be made, C. D. Cotten, Birmingham Southern, speaking before the Locomotive Maintenance Officers' Association recently at Chicago, told of the experimental work that was being done on that road to explore the idea of overhauling engines on a fuel-consumption basis instead of an hour or mile basis.

One of the sources of error in the maintenance schedules that are set up on the basis of hours or miles is the fact that they do not take into consideration the load factor in the three classes of service in which Diesel-electric locomotives are used nor does it take into consideration the fact that the variations in that factor are due to a wide variety of conditions on individual roads. Therefore, it seems reasonable that any idea that relates the overhaul periods more directly to the service which an engine renders may give the user of the engine an opportunity to establish those periods in a manner which will result in the greatest long-range economy.

The experiments on the Birmingham Southern, which are outlined in the discussion of the report on Diesel Mechanical Maintenance elsewhere in this issue, were predicated upon the establishment, for example, of the pulling of pistons on 660-hp. switchers after a total fuel consumption of 160,000 gallons. Immediately it was found that between two locomotives there was a difference in the term of service of 4,843 hours: 22,757 hours in one case and 27,600 hours in the other. As the experiment was extended to other locomotives it was found that the service periods varied from 14,000 hours to as much as 41,600 hours, depending upon a variety of mechanical and other conditions. It was found, for example, that after having established the experimental 160,000-hour fuel-consumption basis for 1,000-hp. switchers it later seemed advisable to reduce it to 120,000 hours in the light of experience.

The purpose of calling attention to the details of this experiment here is that it appears to have considerable merit and that it deserves careful study with the idea that at the outset we may be approaching some of the problems of Diesel maintenance in a more intelligent manner than has been the case with traditional practices with steam power. Experience with internal-combustion power in other fields may indicate that the arbitrary miles-or-hours overhaul basis is not sound.

Cutting the Coal Bill

In a report presented before the Master Boilermakers' Association during the recent Coordinated Mechanical Conventions at Chicago, a committee on improving the steaming qualities of locomotives estimated that it requires approximately 30,000 lb. per hr. of steam to draft a conventional 6,000-hp. locomotive when operating at or near maximum capacity. As this is in the neighborhood of 30 per cent of the steam generated by the boiler, the effect on fuel cost is both large and obvious. More important, from the standpoint of the mechanical department man, is the fact that this effect is one that lends itself to a possible and substantial reduction. The committee dealing with locomotive steaming qualities estimates that, with mechanical drafting, the amount of steam required to produce the draft could be reduced by some 16,000 lb. per hr., a reduction which should be sufficient to increase the overall efficiency of such a locomotive by approximately one-sixth.

Past failures of the induced draft fan, before and during the early twenties, have caused motive power men to greet suggestions for its revival with anything but enthusiasm. Today, however, metallurgy and other sciences applicable to fan design have advanced tremendously compared to their status when previous experimentation was conducted. Similar advances in automotive and fuel engineering have made the modern high-compression automobile engine entirely possible today, whereas its development would have been almost impossible 25 years ago without the improved metals, fuels and design experience now available. Could not a similar situation prevail with respect to the induced draft fan insofar as recent scientific development and advances can provide success where only failures occurred previously?

Evidence accumulated on a Norfolk & Western switching locomotive with mechanical drafting supports an affirmative answer to this question. The first fan installed on this locomtive encountered the anticipated difficulty of a short service life of the impeller due to abrasion. Its life was only 104 hours. The present fan impeller is still operating after more than 1,000 hours of service. Based on results of impeller service tests to date, the life of the next impeller to undergo test is estimated at more than 2,000 hours. The decision of the N. & W. to convert a second switcher to mechanical drafting is indicative of the

present-day practicality of this means of locomotive drafting.

There seems little reason why mechanical drafting would not be as feasible for a high-capacity road locomotive as for a switcher, and worthy of at least a test installation. For it is with this class of power that the really worthwhile savings can be attained, and an appreciable dent made in the $460,000,000 annual railroad coal bill.

A. A. R. Recommendations

Two recommendations, covered in circular letters recently issued by the A.A.R. Mechanical Division, cover subjects which are apparently receiving less than the desired attention.

One of these relates to freight-car side frames and bolsters which are required to meet certain dynamic and static tests before specific designs are approved for interchange service, this limitation applying both to new and replacement castings and for large or small quantities. Railroads which order even a small number of non-A.A.R.-approved side frames, for example, for use in repairing existing trucks of older design are doing so in direct violation of the rules of interchange.

It is suggested that when such orders are received, manufacturers review approved designs with the railroad or private car owner and cooperate with the car construction committee by substituting the one closest to the design required, even though this may necessitate some changes in the truck. In practically all instances, satisfactory approved designs of side frames and bolsters can be found, especially since existing regulations permit manufacturers to make numerous specified alterations in approved designs without resubmission for test.

The second recommendation pertains to hot boxes and particularly the use of kerosene as a thinner. Complaints are being received that kerosene is sometimes applied as a cut-back in journal boxes during winter months on account of the oil becoming congealed.

Since kerosene lowers the flash point of car oil and reduces its lubricating value, its use is at best a temporary expedient, almost sure to cause trouble later, and this fact should be strongly impressed on all car inspection and maintenance forces. The lubrication commitee advises against using any oil with a flash point lower than 350 deg. F. as a cut-back for thinning purposes and recommends hot car oil as the best thinner to use in journal boxes.

Watch Those Wheels

At a large railway shop now devoted almost exclusively to Diesel locomotive repairs, the general shop arrangement, track pits, cranes and other equipment, are well adapted for expeditious performance of the work at hand. Portable and fixed scaffolds, or platforms, give convenient access to locomotives at the desired levels. Diesel engines removed for general overhaul are mounted between circular steel end plates. These plates may be easily rotated to bring any desired part of the engine to the top for maximum ease in working.

Particular attention is paid to electrical maintenance which constitutes such an important part of Diesel locomotive repairs, and electric motors, thoroughly reconditioned and with counterbalanced armatures, are like new when ready for re-application in the trucks. Before final assembly in the truck, each motor and the pair of wheels to which it is geared is mounted on a floor stand or support and electric power supplied to the motor is allowed to revolve the wheels at reasonable speed for a period of 30 minutes, or more. This gives a preliminary break-in and test of the armature bearings and the spur and ring-gear meshing which tends to permit detecting and correcting defects before parts are assembled in the completed truck.

One other important condition which this particular test permits making is the concentricity of wheel treads. Of what value is it to balance and install motor armatures carefully and then exercise less care in the balance and mounting of Diesel locomotive wheels? Yet the test mentioned sometimes shows visible wobbling or eccentricity of wheel treads of possibly 1/16 in. or more. A 42-in. Diesel wheel makes about 740 revolutions a minute at 90 miles an hour and the resultant hammer blows on truck parts and track may be more readily imagined than excused.

Diesel locomotive wheels, for road service at least, are normally machined all over except the plates and, when bored in well-maintained mills, may be assumed to be reasonably well balanced and having treads concentric with the journals. To make absolutely sure of the latter characteristic, however, a number of roads are grinding treads lightly after the wheels are mounted and it has been found that this practice is well worth while.

The advisability of balancing Diesel locomotive wheels dynamically for high speed service is more problematical and, in fact, the question is not being generally raised at the present time. If, however, tests now being conducted by the Association of American Rrailroads in conjunction with the Budd Company indicate the need for more accurate dynamic balance, as well as concentricity, in streamline passenger car wheels, the assumption is that Diesel locomotive wheels will require similar treatment.

A Needed Service

Everyone attending conventions knows that some of the most valuable information made available at such gatherings is exchanged in private conversations taking place before or after formal sessions of an association or society. In a sense the open meeting on railroad welding

held at the recent annual meeting of the American Welding Society at Philadelphia was an expanded version of this kind of an exchange in which the topics of conversation were not limited by the scope of a technical paper.

In deviating from the usual technical-society procedure of presenting and discussing a prepared paper at a formal session the A.W.S. Railroad Welding Committee offered the railroads an unusual opportunity to get practical help with their welding problems. Except for a brief introductory talk on each subject, the entire meeting was devoted to an informal discussion of the welding methods used in the construction and repair of cars and locomotives. Although a program outlined the subjects to be covered, the meeting had no limitations on the problems to be discussed as long as they were in the railroad welding field. The success of an informal discussion on welding depends entirely on the ability of those making the arrangements to bring together the men with the problems and men who knows the answers. Chairman L. E. Grant, engineer of tests, of the Milwaukee did a very fine job in getting an attendance at the meeting of 40 per cent railroad men and arranging for the presence of many outstanding authorities on the subject of welding.

Meetings of this kind should become an important addition to the many ways in which the American Welding Society serves the railroads. With practically all cars and locomotives being fabricated by welding and with the hundreds of maintenance jobs done by welding the railroads should welcome this chance to get help with their everyday shop welding problems. It is a service that the society should continue and one that the railroads should acknowledge by giving it their full support and participation.

We Can't Go Back

Most people who know anything about a spectroscope, think of it rather vaguely as something which is used to weigh the stars, something which was used to discover helium on the sun, and not as a workaday device in the service of a railroad. A Littrow-type quartz-prism mounting spectrograph, a non-recording type Baird densitometer, and a Dietert A.R.L. type direct-current arc control, are nevertheless being used regularly by a railroad to determine the quality of its Diesel lubricating oil.

This sounds horribly scientific and complex, but actually the process is very simple. Equal samples of new and of used oil are burned separately to produce ash. If there is an increase of ash in the used oil, it is placed in the electric arc of the spectroscope, and the resulting light makes lines on the spectroscope scale. The position of the lines shows what elements are in the oil. If it is iron, excessive wear of rings or other parts is indicated. Bearing wear may be shown by copper, silver or lead, and such things as silicon would indicate undesirable and abrasive foreign material.

The introduction of the spectroscope does serve to indicate a radical change in railroad maintenance procedure. It is said that a Diesel-electric locomotive maintenance shop is a good shop, or not a good shop, depending upon whether or not the superintendent is a precisionist. If a steam locomotive knocks too badly, we fix it. If a Diesel locomotive engine starts to knock, it is too late.

This condition does not of itself mean higher maintenance costs. It does mean working to much closer tolerances, learning a lot of new things, including electrical circuit diagrams, the use of new instruments and measuring devices, etc. It would be simpler to work as our forbears did, with a hammer and a chisel, but it wouldn't be nicer, and it would not permit the railroads to make the progress they must make to retain their competitive position in the transportation industry. There is just one direction to go, and it isn't back.

NEW BOOKS

FAN ENGINEERING. *Fifth Edition. Published by the Buffalo Forge Company, Buffalo, N.Y. 808 pages, 4½ in. by 7 in. Price, $6.*

This handbook on air, its movement and distribution in air conditioning, combustion, conveying and other applications employing fans contains numerous charts and tables useful to the air-conditioning engineer and fan user, with explanations and solutions of problems. Physics of Air, Fans, Fan Applications, Fans and Air Conditioning are the titles of the four parts into which the book is divided.

ELEMENTS OF RAILROAD ENGINEERING. *Sixth Edition. By William G. Raymond, Dean of the College of Applied Science, State University of Iowa; Henry E. Riggs, professor Emeritus of Civil Engineering, University of Michigan, and Walter C. Sadler, professor of civil engineering, University of Michigan. Published by John Wiley & Sons, New York. 442 pages, 6 in. by 9½ in.; cloth bound. Price, $5.*

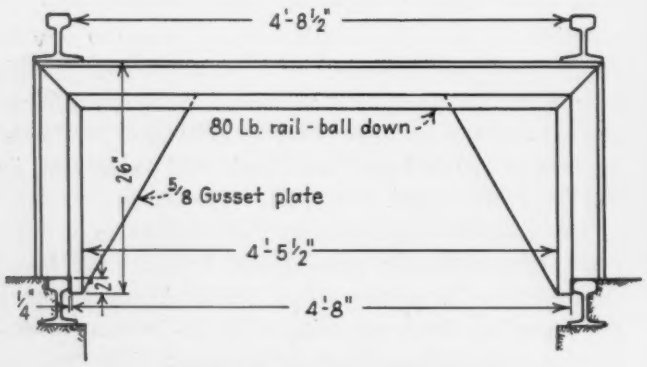
This edition brings up to date the evaluation of competing transportation services and presents the latest developments in motive power which during the past ten years have been necessitated by the increased competition with highway and air transport. The book is intended not only for students specializing in railroad engineering, but also as a general survey of the basic principles of railroading. Two chapters have been added on streamline trains and on power and passenger equipment. Tables have been revised to cover the passenger and freight business of the war years, and other sections have been rewritten to include information in line with current practices. Part I sets forth the historic nature of railroad transportation and presents the fundafental principles of co-ordination. Part II discusses Permanent Way; Part III, The Locomotive and Its Work, and Part IV, Railroad Location Construction, and Betterment Surveys.

Trestle For Diesel Truck Repairs

Workmen no longer need work in cramped positions when assembling, repairing or inspecting Diesel locomotive trucks as a result of a trestle developed at the Chicago & Eastern Illinois shop, Danville, Ill., for holding mounted wheel sets in position for assembling side frames and other truck parts. The trestle consists of two lengths of rail which are suitably supported about 2 ft. above the level of the shop floor and to which are welded small V-notch blocks whereon the wheels rest to hold the truck in place. The overall length of the trestle is 16 ft. 7 in., and a sufficient number of the V-notch blocks are applied at suitable locations so that either four-wheel or six-wheel trucks can be handled with equal ease.

The trestle is constructed of lengths of 80-lb. rail welded and reinforced by steel plate where necessary. The blocks in which the wheels rest are about 5 in. long with notches a little less than 1 in. deep.

A four-wheel truck on the Diesel truck trestle, showing the wheels resting in the V-notch blocks—When a six-wheel truck is in place, the center wheels rest in the notched block immediately to the left of the block which holds the right wheels in the above truck



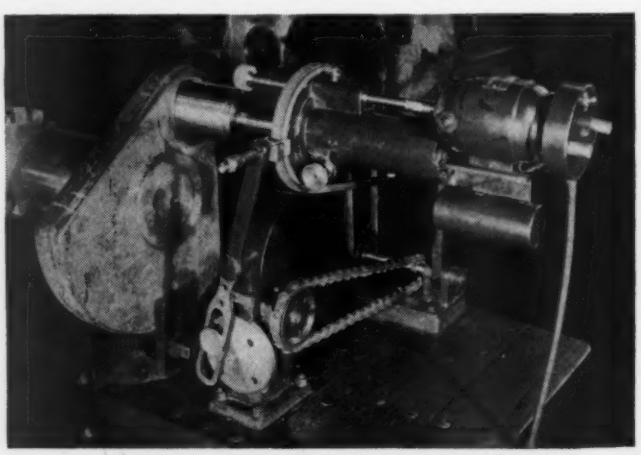
End view of the Diesel truck trestle

Booster Crank Pin Grinder

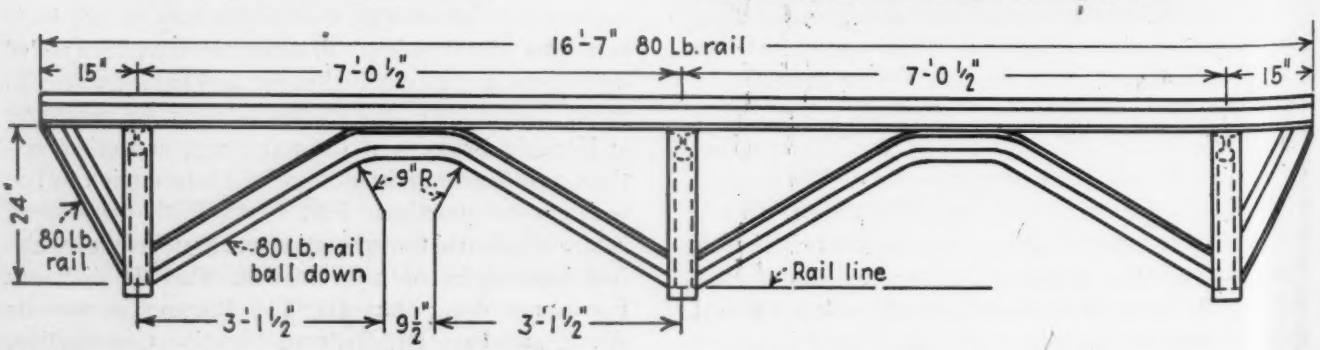
Booster crank pins are ground without interference from the main drive-shaft collar with a portable grinder built at the Springfield, Mo., shops of the St. Louis-San Francisco. With the booster driveshaft mounted on two V-blocks and secured by a clamp on the crankshaft counterweight, the pin is ground in place on the crank.

The grinding operation is performed by a 1-in.-face abrasive wheel driven directly by a counterbalanced ¼-hp. electric motor mounted on the outer end of a cylinderical housing which revolves about a flanged center post inserted in the hollow crank pin. The housing is held rigidly in place by a nut on the center post end which projects through the pin.

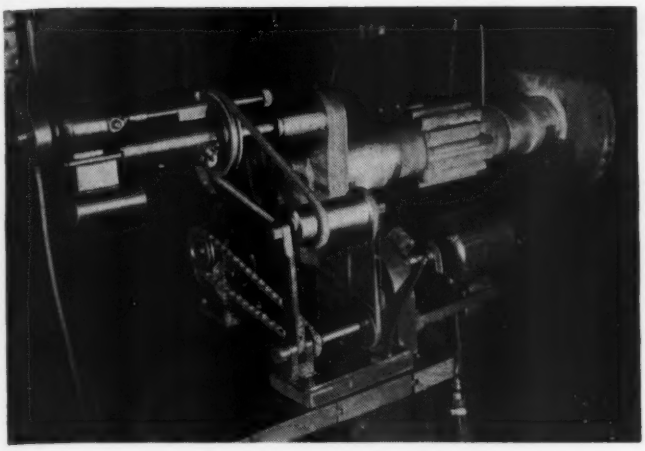
The grinding wheel and counterweighted motor revolve about the center post by belt and gear drive from a bench-mounted motor, as shown in one of the illustrations. Longitudinal feed of the grinding wheel is pro-



The grinding wheel is machine fed along the crank-in surface by the centrally pivoted slotted lever fitting over the crank pin of the wheel shown in the foreground.—The crank wheel is actuated by the cleated belt driving a worm-gear train



Construction details of the trestle for Diesel truck repairs



Booster crank pin grinder showing the individual motor drive to the grinding wheel and the bench-mounted motor drive to revolve the wheel around the circumference of the crank pin

vided by V-belt and worm gear drive from the same bench motor to a circular plate and crank which engages a pivoted arm, the upper end of which has a swivel shoe fitting around the pulley on the main housing. As the crank actuates the lower end of the lever the upper end and abrasive wheel housing are reciprocated on the work. To allow the abrasive wheel to cover the entire length of the crank pin, the intermediate pulley is made about an inch longer than the pin.

Lubricator Tester

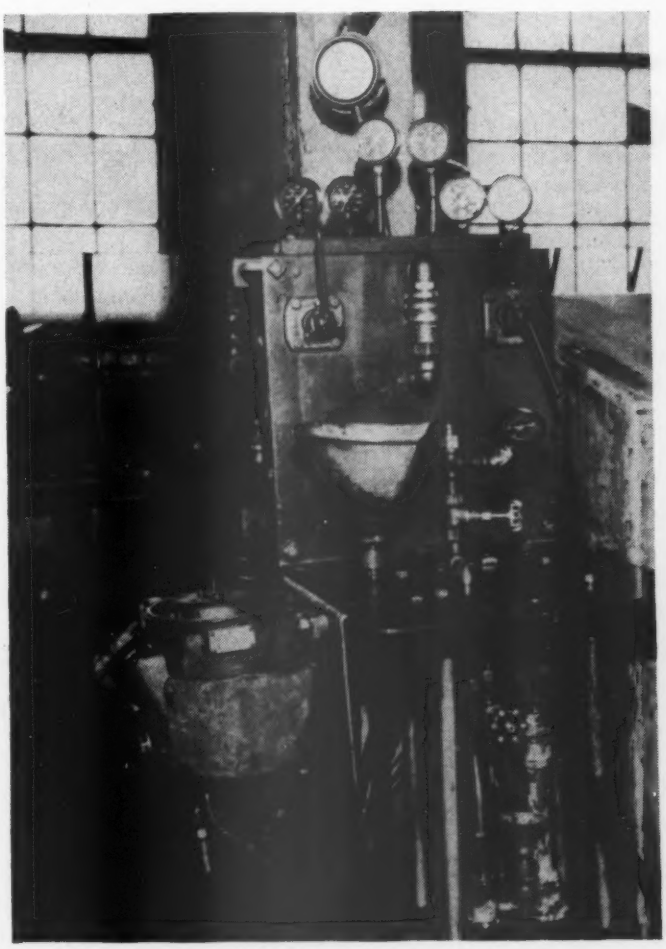
A test bench, constructed at the Union Pacific's Omaha, Neb., shops checks air-pump lubricators under closely simulated operating conditions to see that they deliver the required oil pressure while being actuated by an air pressure equal to or less than that delivered by the low-pressure air cylinder of the air pump to which they will be attached in actual service. The testing bench receives the compressed air from the shop line but is otherwise completely self-contained, including a mounting bracket for the lubricator and the necessary air and oil piping and gauges. The air pressure and number of impulses per minute can be varied independently of each other.

The first step in testing a lubricator is to place it on the ⅛-in. mounting bracket and bolt it in place. After the oil-discharge lines have been connected to the appropriate gauges, the lubricator is cranked either by hand or with an air motor to fill the oil lines. This eliminates the long delay which would occur if the lubricator had to fill the line through the comparatively slow operation by air impulses. The air-line connection is then made and the air flow to the lubricator begun by opening the air-inlet cock. The impulse pressure to the lubricator is adjusted until it is equal to or less than the pressure which will be furnished the lubricator from the air pump to which the lubricator is to be attached. The test proceeds by noting the pressures delivered to each of the six 400-to-600-lb. oil-pressure gauges and seeing that all are up to the required minimum.

The ½-in., 50-to-90-lb. air-line safety valve furnishes and governs the air impulses in conjunction with an air reservoir approximately 6 in. in diameter by 20 in. long. The air from the shop line passes through the reservoir to reach the safety valve. The inlet to the reservoir is choked so that the safety valve will pop and reseat continuously and thus provide the necessary air impulses. The choke restricts the air entering the reservoir to an amount small enough to permit the lifting of the safety valve to drop the reservoir pressure and cause the valve to reseat, as it is this alternate lifting and seating of the safety valve which furnishes the impulses that drive the lubricator. The pressure at which the impulses are furnished is measured by an air gauge connected to the top of a tee in the line between the safety-valve exhaust and the air operating piston of the lubricator. The impulse pressure is changed by the adjusting nut of the safety valve. Blowback rings adjust number of impulses per min.

Only slight modification of the safety valve was necessary to obtain the desired characteristics and functions for testing the lubricator. Three of the blow-back holes were plugged with ⅛-in. machine screws while two were left open to get the most favorable rate of pressure dissipation. The sixth blow-back hole was bored and tapped for the ¼-in. pipe that leads to the lubricator operating piston. The safety valve threads to an elbow which has a rigid mounting as a protection against air leaks resulting from vibration. A reducing flange, to the large threads of which the inlet-air pipes connect, is spot welded to the back of the bench and to the nipple which threads to the elbow that holds the safety valve.

Terminal checks are also tested on the same bench. A hand pump mounted on the base of the bench generates the necessary pressure which is delivered to a vertical piping arrangement that extends upward through the normal top working surface of the bench for a distance of about one foot. A gauge mounted on the vertical line measures the opening and closing pressures of the terminal checks. A funnel attached to a length of pipe extending below the top of the bench drains the oil.



Bench for testing air-pump lubricators with a lubricator mounted and ready for test—The hand pump in the bottom tests terminal checks—The pipe-and-funnel arrangement drains the oil from terminal-check tests

Air Brake Questions and Answers

The 24 RL Brake Equipment for Diesel-Electric Locomotives—Parts of the Equipment—Locomotive A Unit

AUTOMATIC BRAKE VALVE OPERATION
RELEASE AND CHARGING

728—*Q.—What is the normal position of this valve?* A.—Seated to prevent flow to chamber *B*.

729—*Q.—To where does the other branch lead?* A.—To release valve *22*.

730—*Q.—What is the normal position of this valve?* A.—Seated, being held there by spring *106* preventing flow of main-reservoir air to passage *13*.

731—*Q.—When is this valve unseated?* A.—When valve handle *38* is depressed.

732—*Q.—To where does the air flow through the* DS-24 *brake valve from connection* 30? A.—(1) To the duplex air gauge; (2) to sanding valve *279;* (3) to chamber *A* of the service application position; (4) to the warning port and (5) to the *D-24-A* feed valve.

733—*Q.—Is the sanding valve* 279 *open?* A.—No, the sanding valve is seated to prevent flow of air to passage *9* and the sander pipe.

734—*Q.—To where does the air flow from chamber* A *of the service application portion?* A.—Through choke *K* to chamber *B* passage *10* and pipe *10* to charge the safety control system.

735—*Q.—To where does the air from pipe* 10 *flow?* A.—To the check valve and volume reservoir and to the *H24-D* relay air valve.

736—*Q.—Trace the air through the relay air valve.* A.—Through passage *10* and chamber *A* past unseated supply valve *8* to chamber *B* and passage *3*.

737—*Q.—Where does the air flow from passage* 3*?* A.—To pipe *3* to the diaphragm foot valve, past unseated valve *6* through pipe *3* and there to passage *3* in the *DS-24* brake valve.

738—*Q.—Where does passage* 3 *lead to?* A.— The seated dead-man's check valve *351*.

739—*Q.—What determines the pressure passing through the* D-24-A *feed valve?* A.—The selector cock.

740—*Q.—How is this?* A.—With the selector cock in controlled-release position, main-reservoir air is reduced to the feed-valve setting, otherwise the air remains at main-reservoir pressure, flowing through passage *21* to chamber *A* of the *DS-24* brake valve.

741—*Q.—To what passages does the air connect from chamber* A *of the* DS-24 *brake valve in release position?* A.—To passage *4* and *2*.

742—*Q.—What does passage* 4 *connect to?* A.—To passage *5* by cavity *Q* in the service-application slide valve *114*, permitting the air to charge the equalizing reservoir and chamber *D* on the face of the equalizing piston *77*.

743—*Q.—What communications are open from passage 2?* A.—Passage *2* connects air from chamber *A* to cock *204*, passage *43*, cavity *E* and passage *32* to the feed-valve control chamber *G* for control of the feed-valve supply air pressure to that set by the feed-valve handle *26*.

744—*Q.—What other connections are made from passage 2?* A.—To both sides of cut-off piston *146*.

745—*Q.—With air on both sides of this piston, what happens?* A.—With air pressures balanced on both sides of the piston, spring *155* moves the piston to unseat the piston valve.

746—*Q.—With the piston valve unseated what connections are made?* A.—This permits air in passage *2* to flow to equalizing-piston chamber *N*, to the emergency vent-valve chamber around spring *245*, and to pipe connection *I*, charging the brake pipe.

747—*Q. —Describe the flow of brake-pipe air from the* DS-24 *brake valve.* A.—The air in the brake pipe from the *DS-24* brake valve flows to charge the *B-3* conductor's valve, which initiates an emergency application when operated, and to the *D-24* control valve.

748—*Q.—Describe the flow of brake-pipe air in the control valve.* A.—Entering the *D-24* control valve through the combined dirt collector and cut-out cock, the air flows through passage *I* to the spring side of vent valve *41*, to the top of the accelerated release check valve *53a* and ball check *52a* and through strainer *9* to chamber *A* on the face of service piston, and chamber *B* on the face of emergency piston.

749—*Q.—What is the position of the service piston after the brake-pipe air enters Chamber* A *against the piston face?* A.—The position of the service piston during charging depends on the rate of rise in brake-pipe air. If the rise is comparatively rapid, as during initial charging, the service piston and slide valve are moved to the innermost position.

750—*Q.—What is this position called and what takes place?* A.—The innermost position is called retarded recharge in which piston *94* seals on its gasket *87*, compressing return spring *109* and moving return spring cage *108* to the left.

Questions and Answers on Locomotive Practice

By George M. Davies

(This column will answer the questions of our readers on any phase of locomotive construction, shop repairs, or terminal handling, except those pertaining to the boiler. Questions should bear the name and address of the writer, whose identity will not be disclosed without permission to do so.)

Tempering Vanadium Steel

Q.—What is the purpose of tempering carbon vanadium steel forgings?—R.E.K.

A.—The recommended heat treatment for carbon-vanadium steel forgings consists of normalizing and tempering. The principal purpose of tempering is to remove the stresses set up during normalizing. The ductility is increased and the strength reduced somewhat, approximately in proportion to the tempering temperature, particularly as it approaches the limiting temperature of 1,250 deg. F. Tempering consists of reheating uniformly the normalized forging to a temperature below the critical range, usually between 1,050 deg. and 1,200

deg. F., holding this temperature for about one hour per inch of maximum diameter or thickness and cooling either in the furnace or preferably in still air. The rate of heating for tempering should be such that the total time required is at least 30 minutes per inch of maximum diameter or thickness. Tempering close to or within the critical range, i.e. above 1,250 deg. F., will produce a partially spheriodized structure, with resultant lowering of the fatigue or endurance properties.

Driving-Box Oil Grooves

Q.—In oiling the shoe and wedge face of a driving box, should the oil grooves be across the face of the box?—R.E.A.

A.—The general practice is to have the oil grooves horizontal across the face of the box at intervals along its height. These grooves are made horizontal so that the oil in running from groove to groove must cross the surface of the box, giving it the desired lubrication. The use of zig-zag diagonal grooves for the pedestal faces of driving boxes is not desirable as the oil follows down these grooves and does not lubricate the surface which needs it.

Good Combustion

Q.—What are the essential factors for burning coal in a locomotive firebox? What are the effects of too much or too little air being admitted into the firebox?—R.V.K.

A.—The requirements for complete burning of coal in the firebox are air in sufficient quantity, a temperature in the combustion space high enough to start and sustain burning, time enough for the fuel to burn, and a thorough mixing of the fuel with the air. Other considerations are the desirability for a thin, even fuel bed over the entire grate, the proper amount of fresh fuel on the bed at any given time and the porosity in the fuel bed.

As the coal is fed to the firebox it must be distributed evenly on the fire. Air penetration of the fuel bed provides the oxygen for combustion in the fuel bed, and the gases which are distilled off the surface mix with unused air passing through the bed. In general, it has been demonstrated that only about one-half of the air required for combustion should be passed through the fuel bed since, regardless of the firing rate, only one pound of fuel will be gasified for every seven pounds of air admitted through the fire; anything beyond this amount of air would produce better results if supplied above the fuel bed or as secondary air to be admitted at some other advantageous location.

What happens when a fire bed is poorly maintained is that bright spots often become holes through which excess air passes to chill the firebox or mix with the unburned gases in a haphazard fashion.

When the air supplied to the combustion space is greatly in excess of that required for good combustion it has several adverse effects. It robs useful heat from the combustion space and carries it out the stack. If admitted through an open firedoor, as in hand-firing, it lowers the temperature of the gases entering the flues and may drop the superheat to an undesirable temperature; the chilling effect lowers the firebox temperature with a slowing-up of the combustion process.

Good combustion means that a maximum amount of carbon in the coal is burned and combined with available oxygen to produce the maximum carbon dioxide in the gases going out the stack without smoking. When the firebox gets too little air for the fuel being burned carbon monoxide is produced with a consequent drop in the liberation of heat.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

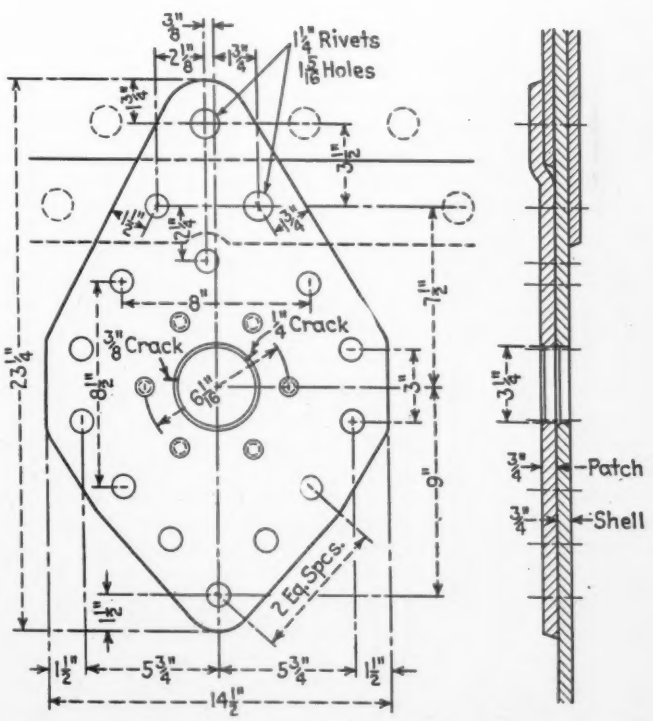
Welded Boiler Advantages

Q.—What are the advantages to be gained by the use of all-welded boilers for locomotives other than the elimination of the circumferential and longitudinal riveted seams?—R.E.A.

A.—The elimination of the circumferential and longitudinal riveted seams is perhaps the greatest advantage of the welded boiler over the riveted boiler. However, other advantages would be: The smooth contour of a welded boiler permits much easier and better application of boiler lagging and jacket; the inside surfaces are smooth which contributes to easier and more satisfactory washout; on many modern locomotives the saving in weight of the welded boiler is an important item, this saving varying with the size and type of locomotive and may be from 3,000 lb. to 6,000 lb. The savings in maintenance costs with a welded boiler is likely to be an important item due to the improbability of any cracks developing.

Check-Valve Patch

Q.—A check valve hole has developed cracks which require a patch. The check-valve hole is directly below the longitudinal



Diamond-shaped patch applied to check-valve hole close to longitudinal seam

seam, which makes it practically impossible to apply a conventional diamond-shaped patch. Should a circular patch be applied in such a case?—F.E.M.

A.—The illustration shows a typical application of a diamond-shaped patch applied to a check-valve hole located close to the longitudinal seam. The patch is designed to use two rivets of the longitudinal seam and add a one-inch rivet in the outer row of the longitudinal seam. This type of patch can be designed to maintain the proper efficiency which could not be obtained with a circular patch.

Alteration Report for Throat-Sheet Patch

Q.—Is it necessary to file an alteration report covering a patch that is applied to an outside throat sheet? The throat sheet in question is typical in that it has a circumferential seam connecting it to the third boiler course and extending up to the centerline of the boiler. The back of the throat sheet is riveted to the outside wrapper sheet. The patch was applied to the vertical outside knuckle, between the wrapper sheet and third course.—E.V.K.

A.—The general practice is to consider the entire outside throat sheet as a stayed surface for which no alteration report is filed. The throat sheet is generally flanged in one piece with the radii of the corners being self supporting. As a rule throat-sheet patches along the outside knuckle are designed to include the seam rivets in the wrapper sheet and the circumferential seam attaching the throat sheet to the third course. Thus, even though the patch is not in a stayed surface area, by following the original contour of the throat sheet it has the same characteristics as to strength as the original throat sheet.

Diesel Locomotive Questions and Answers

By J. R. Benedict

Q.—How will dirty and improper seating of pressure-pump screens cause low oil pressure?

A.—Dirty, or improper seating of pressure pump suction screens and scavenging pump suction screens will result in a reduction of the volume of oil being pumped through the system. The pressure-pump suction screens are very important. They are the final means of preventing any accumulation such as sludge (a product of lube oil oxidation), metal chips, pieces of filter elements, cloth, etc., from entering the main bearing system. The scavenging pump suction screens will prevent any large objects, such as nuts, bolts, wire, rags, etc., from reaching and damaging the scavenging pump. Improper seating of these pump suction screens will permit air instead of lube oil to be drawn into the lube oil system, thus greatly reducing the volume of oil being pumped. Care should be exercised at all times when removing any suction screen for cleaning, so that the screen body is not scraped against the side of tank from which the screen is being removed, as any dirt that is scraped from the screen may drop to the bottom of the tank and thus pass directly to the Diesel engine and cause serious damage. Always determine that the screen is securely seated, before retaining nuts are pulled down tight. On F3 locomotives examine carefully the rubber oil-ring seals and seats to the pressure-pump suction screens. The ring seals must be clean and free from all nicks or burrs. The oil ring itself must not be kinked or twisted.

Q.—What causes diluted or emulsified oil and how can they be eliminated?

A. Diluted or emulsified oil is caused by fuel oil leaks. Fuel oil leaking into the lubricating oil system may be located by checking for leaks at the following locations: injector fuel inlet and outlet pipes at their connection to the fuel manifold and injector body, injector control-rack port, injector follower housing and the injector filter caps. Emulsification will be the result of water leaking into the oil. A thorough investigation for defects should be made of all lower cylinder-liner seals, upper head seals, cracked cylinder stud wells, cracked crankcase, cracked cylinder liner at its bottom and a cracked top of cylinder head. On 16-cylinder engines check the oil overflow port in front of the crankcase for water leaking from the oil-cooler assembly. During routine engine inspection careful observation should be exercised for beads of water collecting on fuel oil pipes to the injector, and under lubricating oil filler hole lid. These beads of water will be the first indication of emulsification. Change oil if necessary.

Q.—What can be done about a defective gauge?

A.—The low oil pressure reading may be due to a defective gauge. Remove and check the gauge in usual manner. Always thoroughly flush gauge pipes before reinstallation.

Q.—What is the procedure when the oil level is low?

A.—The oil level should be within 2 deg. of the full mark on the bayonet gauge under normal operating conditions. After the lubricating oil system has been completely drained and a fresh charge of oil has been put in the engine oil pan the bayonet gauge will read SYSTEM UNCHARGED. When the engine has been turned over several times and the filter tank, oil cooler radiator, etc., have been filled, the bayonet gauge will read "system charged." With the engine operating and all pipes, parts etc., filled, the oil level will drop until the bayonet gauge reads FULL. Any oil consumption above normal will usually be caused by either a broken drain pipe, a drain valve open (the drain pipes should always have a pipe plug inserted in their ends), scavenging air filters clogged (engine starving for air and drawing an excessive amount of oil from blowers), or broken pipes and bad gaskets on outside of Diesel engine.

Q.—How can defective parts cause low oil pressure?

A.—The low oil pressure may be due to broken pipes or worn bearings. The engine should be examined for broken pipes to rocker arm assemblies and in accessory and blower gear drive housings. Worn bearings may be determined by connecting an external pump to the system, preferably to the 50-lb. relief valve manifold and pumping crankcase oil through the system, observing the various bearings for leakage. Always check for a possible worn pump.

Q.—What will cause the piston-cooling oil gauge to drop below normal?

A.—If the lubricating oil piston-cooling gauge pressure drops below normal, the trouble may be in one or more of the following items: (1)—Dirty or improper seating of pressure pump suction screens; (2)—diluted or emulsified oil; (3)—defective gauges; (4)—insufficient quantity of oil in system, and (5)—cracked piston-cooling manifold or cracked "P" pipes.

Q.—How can the first four causes be dealt with?

A.—The first four causes should be checked and corrected as given for these same causes in the section of this discussion on the main bearing.

With the Car Foreman and Inspectors

Mechanical Compressor Repairs*

The difficulty experienced by the Union Pacific with oil in the air brake system has been decreased by changing to a type of compressor oil which meets the following specifications:

1. Well refined mineral oil of uniform quality.
2. Free from water and foreign substance.
3. Viscosity at 210 deg. F. between 56 and 60 Saybolt-Second Universal.
4. Viscosity index not less than 80.
5. Flash point not less than 400 deg. F., and fire point not less than 465 deg. F. as determined by Cleveland open cup tester.
6. Carbon residue not greater than 0.50 per cent as shown by the Conradson method.
7. Neutral, not showing presence of free mineral acids or alkali when shaken with water using methyl orange and phenolphthalein as indicators.
8. Pour point not higher than plus 20 deg. F.

Continuous operation of mechanically-operated air compressors on Diesel-electric locomotives requires high standards of maintenance and testing. Correct synchronization of air compressors on such locomotives is of paramount importance to insure that each compressor performs its proportionate share of the work, thereby avoiding conditions that eventually contribute to abnormal maintenance.

Specifications on compressor lubricating oil for the Union Pacific are outlined, testing procedures followed at periodic and trip inspections of the compressor are described, and details are given for the shop work involved in giving general repairs to this type of compressor

Trip Inspection

Drain intercoolers by use of drain cock provided.

Check oil level in crankcase; if excessive oil usage is indicated, determine cause and correct.

Check safety vale on intercooler for proper operation by pulling handle provided.

Check unloading and loading of compressors to determine if compressors are synchronized.

Examine piping to compressor for loose clamps and leaky pipes.

Monthly Inspection

Examine unloader diaphragms when so equipped, renewing if necessary.

Quarterly Inspection

Remove unloader assembly and inspect condition of springs, plungers and rings, replacing worn parts.

Remove valve assemblies and inspect for broken springs and cracked valves.

Clean carbon from valve assemblies, reface valve seats if necessary, and apply new valves when required.

In replacing valve assemblies, special care must be taken to determine if surfaces of assemblies and seats in cylinder heads are clean to insure tight joint.

Drain oil in crankcase, removing and thoroughly cleaning oil filter units and strainers, replacing if defective. Thoroughly flush crankcase with distillate filling crankcase to proper level with new approved compressor oil.

Test compressor for capacity by orifice test, as prescribed by I.C.C. regulations.

Semi-Annual Inspection

In addition to work required to be performed at monthly and quarterly inspection periods, remove intake air filters and wire mesh strainers when so equipped; renew filter units when necessary; remove cylinder heads and thoroughly clean with cleaning solution and by blowing with compressed air.

General Repairs

When inspections and tests indicate general repairs are required, remove compressor from service and place in shop equipped to make required repairs.

After removing from locomotive, clean exterior of compressors to prevent dirt from entering internal parts during course of repairs.

Disassemble compressor, and after marking parts to insure that if re-applied such parts will be returned to original locations, place cylinder heads, cylinders, crankcases, crankshafts and unloaders in approved boiling cleaning solution and leave in this solution long enough to clean completely.

After removing parts from the cleaning solution, thoroughly clean these parts together with all other parts, and inspect to determine repairs and new parts required.

Blow all parts, ports, air and oil passages and pipes with compressed air to insure that there are no obstructions.

Remove oil filter units and clean strainers thoroughly, replacing if defective.

Replace or recondition main bearing and connecting rod bearing surfaces of crankshafts, also main bearing, connecting rod bearing and wrist pin bearing surfaces found to be out-of-round, tapered, scored or excessively worn or otherwise defective.

Recondition air cylinders and pistons found to be out-of-round, tapered, scored or excessively worn or defective; otherwise, replace pistons having excessively worn or defective piston ring grooves.

Hone cylinders that require reconditioning if repairs can be satisfactorily made by this method.

After cylinders are honed, check perpendicularity thereof with flange face, and if out more than .002 in. machine the flange to required limits.

Care must be exercised to avoid shortening the cylinder beyond required minimum limits. When reassembled with the piston in upper dead center position, the top of the piston should be either flush with, or below the top surface, of the cylinder.

If clearance between the piston and the cylinder exceeds maximum limits bore or grind cylinders to the next oversize.

*From a report presented before the annual meeting of the Air Brake Association at Chicago in September.

When an oversize piston is applied, mark the top of the piston to indicate the dimension and attach a metal tag to the compressor to indicate the size of the piston.

Renew all piston rings regardless of condition when compressor is given general repair, exercising care to insure proper placing into ring groove.

Recommendations for proper ring gap vary with the manufacturers. One recommends gap of .030. in. when installing, while another provides a limit of the same dimension for a new ring. The U.P. has installed a number of new rings in compressors of both types, using a gap opening of .0015 in. per inch of cylinder diameter with good results.

Ball and roller bearing assemblies, when so equipped, oil pump eccentrics, plungers and bodies must be carefully inspected for excessive wear and other defects, and replaced when necessary.

Crank pins must not be more than .002 in. out of parallel with main bearings; otherwise, grind pins in definite undersize steps, exercising care to insure that original radius at ends of pins is maintained. If scored, machine oil seal seats sufficiently to eliminate marks.

Polish oil pump eccentrics if no bad score marks are visible.

Recondition or renew oil pump pistons to insure proper lubricating oil pressure.

Rebush and rebabbitt connecting rods that are to be reused if necessary.

Clearance between wrist pins and connecting rods to be such that the weight or the pins will pass them through the rods.

Wrist pins should be fitted to pistons with a thumb push fit.

Check connecting rods and piston assemblies, and if necessary, correct for proper alignment of the piston with the crank pin bore.

When a compressor has been completely dismantled for repairs, it is advisable to fit the connecting rods to the crankshaft before replacing it in the crankcase. When fitting connecting rods to crankshafts and crankshafts to main bearings or roller and ball bearing assemblies, exercise care to insure proper fit on entire bearing surfaces. To obtain proper fit between connecting rods and crankshaft, insert a .0015-in. feeler between connecting rod and crankpin. With bolts properly tightened with 100- to 150-lb. torque, the rod must be free. When a .0025-in. feeler is similarly inserted, the rod should lock on shaft. Remove connecting rods before final assembly of the crankshaft in the crankcase.

If excessively worn or damaged beyond repair, replace oil relief valves.

If the main bearing housing bore is worn eccentric or more than .002 in., replace or rebush the housing.

Examine plungers, cylinders, fingers and pins of unloaders for wear and replace excessively worn parts.

Reface air valve seats and apply new valves, renew springs that do not meet standard requirement; and replace pitted ball checks.

Dismantle intercoolers and clean tubes internally and externally. Remove all paint and foreign matter in order to retain the heat dissipating characteristics of the intercooler. Straighten bent fins and test intercooler before reapplying, and repair safety valve and test for proper pressure adjustment.

Renew all compressor gaskets.

Inspect crankcase breather, renew metallic filter material if so equipped.

Use shims where required to obtain the minimum and maximum clearances when fitting and assembling parts of air compressors.

Pistons and piston rings must be properly fitted and required clearances provided.

When applying pistons to connecting rods, exercise care to insure proper application of wrist pins. After keeper bolts are applied and tightened, they are to be securely locked in position by inserting wire through connecting rods and heads of bolts. Snap rings, when installed, must be in their proper place.

When applying crankshafts to main bearings and connecting rods to crankshafts, and shims are used to obtain required clearances, shim projections must be properly fitted against the shafts to provide the required oil seal, thereby avoiding the loss of oil pressure and providing sufficient lubrication.

After applying crankshaft main bearing caps of friction-bearing compressors, and cap screws are securely tightened, lock cap screws in position by inserting wire through heads of cap screws. After crankshafts and roller or ball bearing assemblies are applied to compressors so equipped, exercise care when applying oil seal to insure proper application and fit to avoid loss of oil and to provide required lubrication.

After pistons are inserted in cylinders and connecting rods are secured to crankshafts by use of bolts provided, the bolts must be securely tightened and cotters applied to the threaded ends.

When applying air valve assemblies, it is vitally important to see that seats are clean and otherwise in good condition, and that gaskets are applied when required between air valve assemblies and the bodies of compressors. Before applying valve chamber covers, the low-pressure unloader assembly or the set screw pressure on spacers must be fully released by turning the low-pressure unloader assemblies or the set screws in counterclockwise direction. After valve chamber covers have been applied and nuts securely tightened, the pressure on the spacers required to hold the valves on the seats must be provided by turning the low-pressure unloader assembly or the set screws in a clockwise direction.

When air compressors are being assembled, the bearing surfaces of crankshafts, main bearings, connecting rod bearings, wrist pins and cylinders must be adequately lubricated with an approved compressor oil.

After reassembling the air compressor and filling the crankcase to the proper level with approved compressor oil, place the compressor on a test rack and operate to determine if in good operating condition for application to locomotives. When applying air compressors to locomotives, extreme care must be exercised to insure proper alignment between rotating shaft coupling.

This report was prepared by C. E. Bergman, engineer, Air Brake and Train Control Maintenance, Union Pacific.

Clamping and Holding Arrangement

The release springs in AB brake cylinders are easily compressed and securely held while disassembling parts preparatory to cleaning, replacement, and greasing by a shop-constructed clamping arrangement in the Union Pacific shops at Omaha, Neb. The piston assembly is dropped into a hole in the bench, and a lever with a fixed pivot at one end fits over the non-pressure head. Depressing the end of the lever opposite the pivot compresses the release spring, the lever being held in the lowered position by means of a hook riveted to the bench

Release spring in AB piston assembly compressed and being held in place for removal of collar

top. While the piston assembly is held in position with the spring compressed, the piston sleeve collar is removed. The lever is released, allowing the non-pressure head to move upward off the sleeve, thus permitting easy removal of the packing seal and spring seat for cleaning, greasing, and applying new parts. The reverse operation is used in putting piston assemblies back together.

The pivot end of the bar is attached to a swivel support through a clevis. The lever is joined to the clevis with a ½-in. bolt through the clevis holes. The lower end of the clevis is bolted loosely to the bench to provide the swiveling action necessary when the lever is depressed. The clevis support consists of a short section of pipe with a central bolt extending through the table top. The lever is made from ⅝-in. by 1-in. iron, and extends with the long side vertical a distance of about one foot from the pivot point. It then opens to a ring with an inside diameter of 6½ in. and an outside diameter of 8½ in. It is this ring which fits over the non-pressure head and forms the contact for pushing down the assembly and compressing the release spring. The total lever length is about 5 ft.

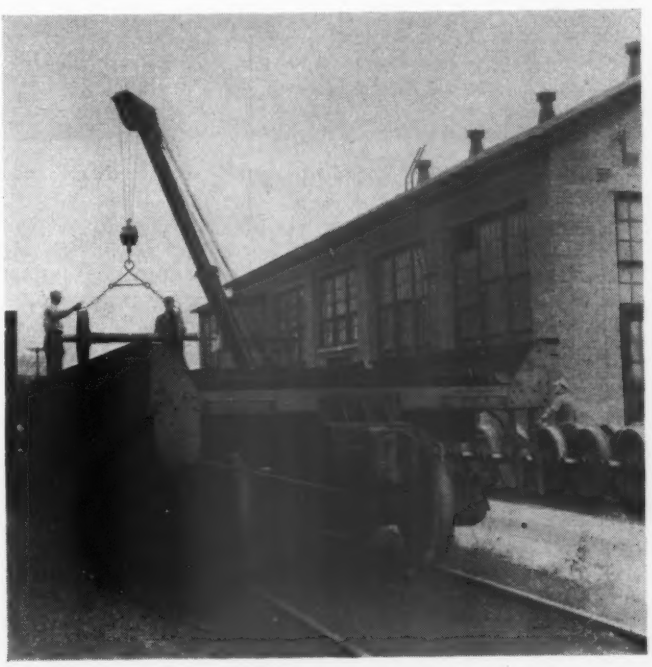
The bench hole in which the piston assembly is placed for dismantling is 12 in. deep and a little over 10 in. in diameter, which is large enough to permit the assembly to be lowered into place easily and positioned while the spring is being compressed. The bottom of the opening is covered with a piece of wood for cushioning purposes. Two other circular holes in the top of the bench give access to oil and rag supplies.

Special Car For Wheel Loading

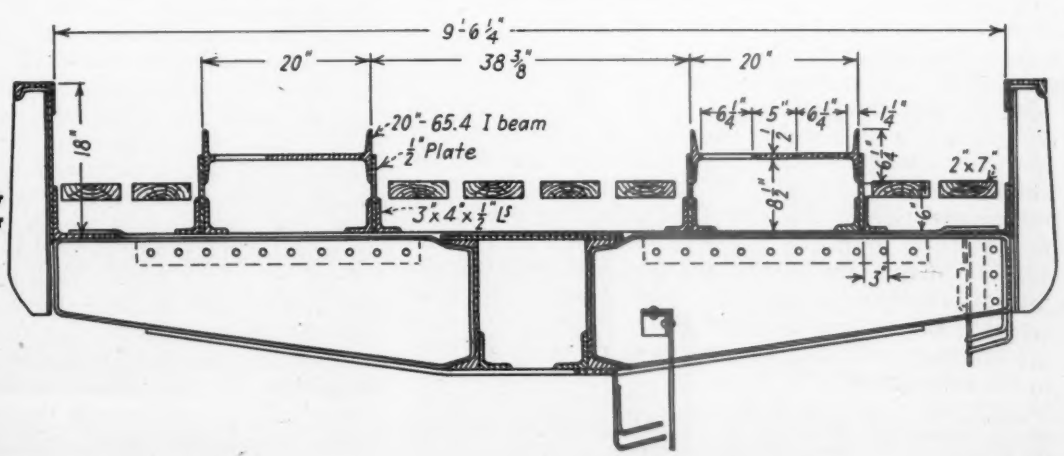
Blocking wheel sets in place is not necessary when the mounted pairs are transported in a wheel-loading car of the type used on the Chicago & Eastern Illinois. The car will handle mounted sets of either 33- or 36-in. diameter wheels, and is loaded by a crane truck. The capacity of the car is twenty mounted wheel sets loaded transversely with each wheel resting in a slot, plus five wheel sets loaded longitudinally. The wheel sets are loaded in a matter of minutes directly from a storage track outside the wheel shop by one man on the crane truck assisted by two helpers who guide the wheels into the slots for loading the transversely arranged wheel sets, and who position the longitudinally loaded sets on top of those mounted transversely.

The wheel loading car was rebuilt from an old gondola car from which the superstructure was removed. The side stakes were shortened and the lower section reapplied with the approximate center riveted to the reinforcing angle running the entire length of each side of the car, and with the bottom part near the bottom of the side sill. To permit this type of side stake application, the reinforcing angle was changed from its position on the original gondola car with the exterior leg in the downward position to a new setting with the bottom of the horizontal leg next to the top of the car floor and with the outside leg pointig upward as shown in the cross section view. The old top chord was riveted to the top of the shortened stakes, and ¼-in. steel sides were applied between the car floor and the top chord. The original cross bearers and cover plates were used, being renewed only where necessary. Slotted I-beams to hold the wheels were riveted in place.

The cars as completed have two 20-in. 65.4-lb. I-beams running the full length of the car on either side. Slots 29 in. long and 6¼ in. wide are cut into the web of each I-beam. The slots are in two rows, 17¼ in. apart and separated by a 5-in. strip of solid metal. Each of the I-beams is riveted to a ½-in. vertical plate which in turn is fastened to two angles 3 in. by 4 in. by ½ in. riveted to the main steel floor of the car. The I-beams



Mounted wheel sets are loaded directly from the wheel storage track of the wheel shop by a crane truck—Here the first pair of wheels is being loaded on an empty car with the two men on the car guiding the wheels into the proper slots—After the car is loaded it is ready for movement without further blocking of the wheels



Cross section of the C. & E. I. wheel loading car

For each four-wheel set loaded transversely, one set is arranged longitudinally

are laid with the web horizontal and with a 38⅜-in. space between the nearest edges of the flanges. Wooden flooring extends between the two I-beams, and between the outer edge of each I-beam and its adjoining side, to furnish safe footing for the workmen who guide the mounted wheel sets into place on the car during the loading operations.

Preparing Passenger Cars For Winter Service*

By E. F. Gross

The preparation of passenger cars for winter service requires closer inspection and improved maintenance prior to and during winter months due to the severe strain on all passenger equipment on account of cold, snow and hard, frozen road beds.

The first thing of importance is hot boxes and this has considerable to do with preparing passenger cars for winter service. The B. & O. method includes giving cars a thorough inspection during the month of November, which may extend into the first week of December. This is done by placing the car over a pit where all wheels can be thoroughly inspected, trucks thoroughly checked, all cars checked for draft slack and coupler conditions, couple height, all journal boxes given periodical attention at this time, and all spring conditions are checked to insure proper condition of cars and trucks. At this time also, brake pins and brake hanger pins are examined and renewed when found worn. Cotter keys are applied or renewed, and they are spread to approximately 45 deg. to prevent originating a defect in the cotter keys.

*Abstract of paper presented at the September 13 meeting of the Car Foremen's Association of Chicago. Mr. Gross is general car foreman of the Baltimore & Ohio Chicago Terminal at Chicago.

During September, October and November, steam end-valves are checked, packing renewed and regulators are reconditioned. Inside steam valves on passenger and baggage cars are checked, and all steam train lines that need repairing or wrapping are taken care of while the car is on the pit. Metallic steam connectors are changed and gauged to see that they have proper clearance above the rail, and all air and signal hose are also changed. We have found that by changing air hose we have eliminated a number of air hose failures on passenger trains due to clutches pulling off. This may be caused by having air hose coupled within a few inches of the metallic connector, and with the steam pressure used in the winter months, it creates considerable heat which takes the life out of the rubber.

Periodic Work Done in Advance

Air brakes are cleaned during the spring, summer and fall months as much as possible, which leaves us a car to place in winter service that does not require anything whatsoever, with the exception of regular maintenance. This permits us to use the men that are assigned to periodical duties on other types of work, to give journal boxes the attention they require during the months of December, January and February.

During July, August and September, we paint vestibules, platforms and steps to keep them in a presentable condition during the bad months when salt used on the steps has a tendency to discolor and deteriorate the metal. Also, at this time the weather stripping is checked and renewed where needed.

To set up a program that should be followed at all terminals, we should endeavor to follow this outline. All air brakes should be cleaned and given periodical attention during spring, summer and fall months. Journal boxes should be given periodical attention the latter part of November and the first week of December. This applies to regular scheduled trains and cars. When giving boxes periodical attention, all journal bearings should be thoroughly hammer tested, wedges gauged, and worn boxes renewed. All brake rigging is thoroughly checked and wheels receive special inspection. A most important factor for operating passenger cars during winter months is closer observation by all supervisors, inspectors and box packers, to prevent man-failure detentions on the road.

Hand Test Journal Boxes on Arrival

I would suggest that box packers meet passenger trains immediately upon arrival at terminals. At this time they should raise the box lids and feel the journals to see if any are running above normal running temperatures. Through this operation we have found a number of defective bearings which would have been potential hot boxes. I know this method has prevented a number of detentions on line of road. On arrival at the coach yard, care should be taken to see that all ice from toilets and lavatories that has formed on the brake rigging, especially where we have truck-mounted brake cylinders, is removed as this has caused brakes to stick due to the levers fouling against ice formations on the trucks bolsters. When the train is given a brake test with the portable truck brake testing machine (with temeprature ranging from below zero to 15 deg. above), all cars should be given a little alcohol in the brake pipe and forced back through the train by air pressure to prevent brakes sticking due to valves freezing up as considerable moisture gathers in brake pipes from condensation. No cars should be left with ground air attached and going through the train lines, as this may cause considerable brake sticking after dispatchment.

While cars are standing in the coach yard, air should be used only when making brake tests.

When we have snow to any extent, all snow should be blown from the cars as much as possible and cleaned out of the couplers and knuckles as this may cause failure of the knuckle to seat properly due to snow and ice being packed in the operating features. Ice formation should be cleaned and removed from generators and other parts that collect ice in transit.

Another item is the complaints from trainmen with respect to baggage car doors not closing properly. It would be well to assign an inspector to make a special inspection of baggage car doors to make sure that they fit properly, have operating features OK and weather stripping in the best condition.

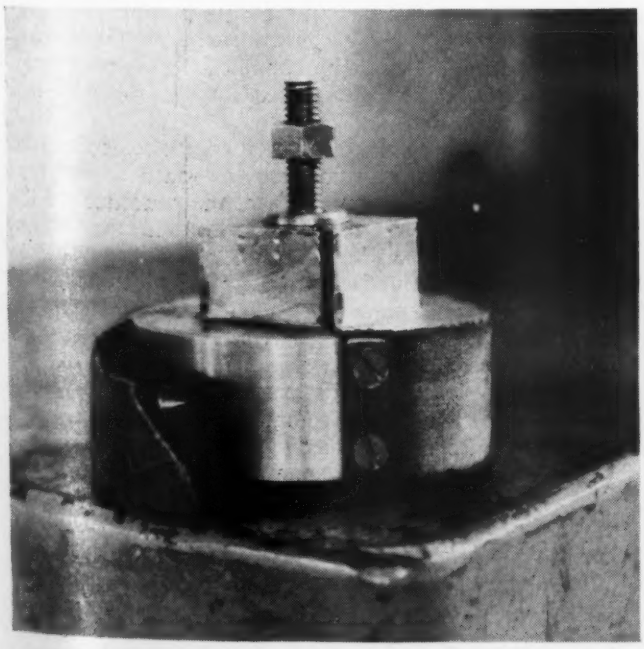
A matter of extreme importance is the necessity of getting in touch with the stores department to find out what material is on hand and due, to be sure you have the material required for winter maintenance of passenger cars when needed.

Unless you do this, the stores department will continue ordering material based on monthly consumption that has been used on re-conditioning work and you will not have the type of material required for winter maintenance. This applies mostly to steam heat equipment.

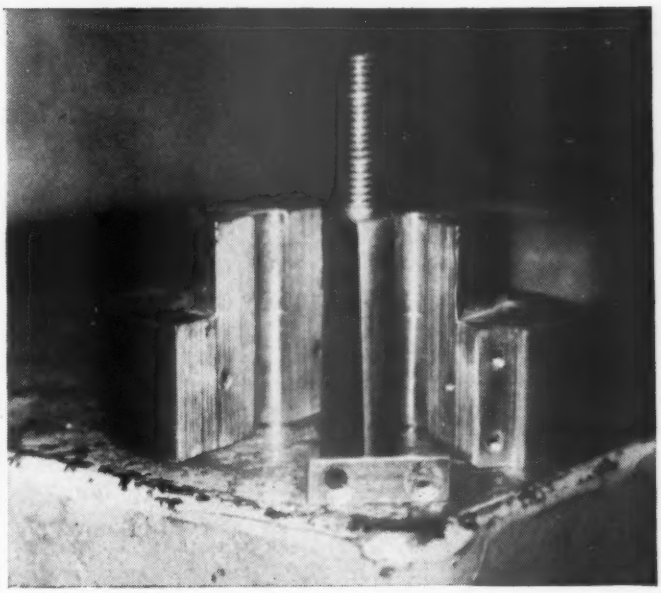
Expandable Emery-Cloth Holder

An expandable emery-cloth holder for use in truing worn Bakelite bushings of AB valves and Bakelite or brass bushings of other air-brake equipment has been developed by the shop forces at the Union Pacific's Omaha, Neb., shops. The holder consists of two semi-circular brass halves fitting together to make a cylinder 3½ in. in diameter and 2¾ in. high to which the abrasive is attached. On top of the circular surface is a boss 1½ in. square and ⅞ in. high. A double-handle wrench fitting over this boss is used to turn the holder for the abrasive operation.

A taper pin, fitting in a taper hole between the two halves of the holder, is used to expand the holder to accommodate small variations in diameter of different bushings and increase or decrease abrasive pressure in the truing operation. The pin has 1¾ in. of ⅜-in. thread on the smaller end to which a nut is applied. When the two halves of the holder are together, tightening this nut draws the taper pin through the hole and expands the holder. The pin is relieved to a flat surface on each of two sides so that in effect it acts as a wedge rather than a taper pin.



Expandable emery-cloth holder with a piece of used emery cloth torn off at one end to show how the cloth is held



Principal parts of the expandable emery-cloth holder

The semi-circular holder halves are held in alignment, but permitted a small amount of movement towards or away from each other by means of two long screws inserted through holes in one half and threaded into appropriate holes in the other half of the holder. These holes start in the circumference and are, of course, at right angles to the straight junction surfaces. The holes are spaced so as to clear the taper hole and pin at the center.

A strip of emery cloth, 2¾ in. wide, is wound around the assembled holder, the ends being held in place by the small double-screw retaining plate, illustrated. This plate fits in a recess, ¼ in. wide and ⅛ in. deep, cut in the circular surface at one end of the holder halves. The plate is held by two small screws with heads fitting in countersunk holes so that they do not project above the surface.

The principal advantage of this particular type of abrasive holder in reconditioning AB valves is its convenience for work at the air-brake repair bench and the fact that a minimum amount of material is removed in truing the worn cylinders.

MECHANICALLY REFRIGERATED CAR TESTED.—Tests of the first mechanically refrigerated railway car to be placed in operation are now being completed on the Canadian National. The car, designed in Vancouver, B. C., by the Dominion Fisheries Experimental Station, recently took a shipment of Delnor frozen fruits and vegetables from New Westminster, B. C., to Edmonton, Alta., as the first in a series of experiments which will extend into next summer. The experimental station's observer on the trip said that the temperature in the car was held at 12 deg. below zero most of the way, that unloading temperature was 10 deg. below and that once on the trip, as a test, the temperature was driven down to 17 deg. below. One freezing unit was used on the car. Next summer tests will be run to determine how cold produce can be kept in hot weather by one unit. The freezing unit can, by the flip of a switch, be changed to a heater to prevent freezing in sub-zero weather.

Brushes for Diesel-Electrics*

By Walter F. Fauerbach†

Good brush performance requires carefully controlled manufacturing and some practical operating experience

ALTHOUGH considerable research and extensive testing has been applied to brush operation by excellent talent and facilities, purely scientific studies of what is known as "brush phenomena" have yet to reduce brush operation to mathematical equations. We must, therefore, draw from experience that data which will best serve our purpose to attain better understanding of practical operation. It is not a cut and dried business. There are things we don't know. It is often a matter of cut and try.

There are quite a few types of brushes,—made of various raw materials. These have been designed for the many types of electrical applications ranging from four volts to a few thousand volts, and in current from milliamperes to over two hundred amperes per square inch of contact area. There are graphite brushes, copper-graphite brushes, various percentages of metals and graphite, carbon brushes, silver-graphite brushes and electro-graphitic brushes.

Electro-graphitic is the term used to indicate a carbon material which has been graphitized by raising the temperature of the carbon to an extremely high level in an electric furnace. This treatment increases the electrical and thermal conductivity of the carbon material, causing it to be highly refractory and very tough. It was originally designed for railroad service which requires the carrying of heavy overloads, running cool at high temperatures and resistance to mechanical shock.

The procedure for the manufacture of the electro-graphitic brush is to compound a mixture of various types of carbons in powder form. This is then mixed with a suitable binder, usually pitch, tar or resins, and pressed hydraulically in a die at a number of tons per square inch. Some brushes are pressed in ranges of ten to sixteen tons per square inch, depending on what density and strength are required.

The pressed block of carbon held together by the binder constitutes the old carbon brush used years ago on motors and generators. It was hard, somewhat abrasive, and it carried sufficient current to perform on the old designs which were confined, in the old days, to current densities below 40 amp. per sq. in. and to low peripheral speeds.

This carbon block, after testing, is subjected to temperatures approaching 6,500 deg. F., and it is in this process the chemical change takes place resulting in what is known as electro-graphitic material. Now we have an electro-graphitic brush material identified by a formula number. By testing, we find its hardness, its breaking strength, its specific gravity and its heat dissipation, and we know just where it stands in comparison with those same characteristics of other formulae. We do not yet, however, have a knowledge of its other characteristics which will determine its suitability in operation.

Brush Characteristics

Specific resistance is the electrical resistance in ohms per inch cube of the material. Measurement of this resistance is not only very useful to the brush manufacturer as an excellent check on the uniformity of the material from batch to batch, but the resistance itself plays a definite part in the overall characteristic of the brush. It represents from 10 to 15 per cent of the wattage loss caused by friction and contact resistance.

Coefficient of friction is a characteristic which determines a good portion of the heat losses in operation. It is of vital importance on applications where high peripheral speeds are encountered. These commutator speeds at times reach as high as 10,000 ft. per min.

Contact drop is the most valuable property a brush possesses and it is the secret of success in commutation. It is measured in voltage loss between the brush and the commutator. It accounts for a high percentage of the total voltage losses. Its influence on all machines directly determines the quality of the commutation.

These three factors, resistance, friction and voltage drop are important not only unto themselves but are interrelated and influenced by each other so that the overall characteristic is that which identifies a grade of brush as a suitable prospect for success on a given application.

Determination of these characteristics in the electro-graphitic material is made by running brushes on a rotating test unit; a test machine used for all grades of that particular type.

Such testing is conducted under controlled conditions in which all factors must be known,—such as the type of copper in the collecting surface, the condition of the rotating member as to balance and vibration, the concentricity of the commutator and condition of its surface as to oxide films, or the lack of them. The accuracy of brushholder measurements, brushholder alignment, exact spring tension, voltage, current, speed, temperature and humidity must all be known quantities. The comparison of many grades made in this exacting manner influences the selection of grades for commercial testing.

While these finely controlled laboratory tests are essential in making comparisons, one grade to another, there are of course additional test facilities designed to determine the durability of brush materials under far less favorable conditions. These tests are designed not only to simulate operating conditions in the field, both electrically and mechanically, but to provide even more rugged conditions.

To complete the story of the manufacture of the brushes, the finished material is cut and ground to size and

*Abstract of a paper presented at a meeting of the Southeastern Railway Diesel Club, Jacksonville, Fla., October 9, 1948.

†Engineer, Morganite, Incorporated, Long Island City, N. Y.

shape, holes are drilled and undercut to provide for the knot which helps to anchor the tamped pigtail, the terminals are pressed on the outside end of the pigtail and the brush is given final inspection before shipping.

Application of Brushes

Electrical manufacturers choose grades of brushes for new designs by means of factory stand tests under various speeds and loads with the aim of selecting that grade of brush which will give the best commutation, temperature rise and efficiency.

The Diesel-electric locomotive motors and generators of today are inherently good commutating machines and little difficulty is experienced due to poor commutation under reasonable conditions of operation.

The factors affecting commutation and proper brush performance are as follows:

Balance of the armature
Concentricity of the commutator
Spacing and alignment of the brushholders
Clearance of the brushholders from the commutator
Clearance of the brushes in the holders
Equalized and proper spring tension
Proper undercutting of the commutator mica
Setting of the holders with respect to electrical neutral
Atmospheric conditions
Humidity

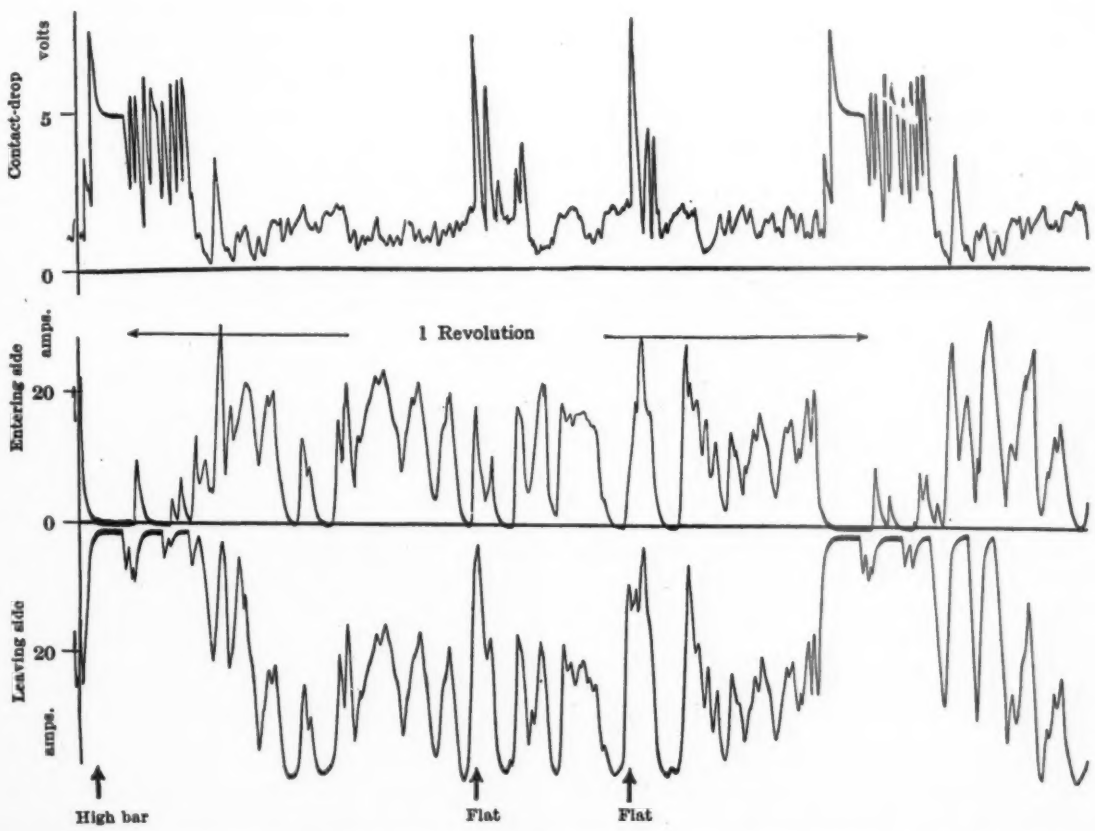
In the testing of brushes under actual operating conditions on the railroad, additional factors must be reckoned with as follows

Vibration due to road bed
Sustained high temperatures and variation of temperatures
Oil vapor
Abrasive dust
Abuses in operation of electrical equipment

Tests of brushes on railroads serve to illustrate that on identical equipment, motors and generators, brush performance and brush life vary widely from one railroad to another, and from one division to another of the same system. No two brush applications are identical. No two applications on the same locomotive or on the same truck are identical.

The eventual deterioration of the ideal performance of new, or newly reconditioned equipment comes to light in railroad service more quickly than experienced in any other service because of the variations in operating conditions, continual vibration, often severe, unfavorable weather conditions, continually changing temperatures of equipment and conditions of commutation in transition.

It is the job of the brush manufacturer to provide a brush which will satisfactorily perform under all road conditions encountered, and with it, provide brush life and economy of operation.



Contact-drop and current in each half of a two-piece radial brush on a commutator having a high bar and two flat spots

Inspection

Inspection of brushes on Diesel-electric locomotives does not differ from the standard procedures applying to any other type of direct current rotating equipment but additional keenness of observation is desirable and also rewarded.

The experience of riding locomotives and inspecting the commutators at the end of each run has proven the theory of the ever-changing film on the commutator and the fact that commutator appearance records the story of the performance of the locomotive. The identity of the engineman who last handled the locomotive may frequently be determined by examination of the commutators.

Slight discoloration of bar edges due to an irregular

operation often recovers during the following trip to a uniformly polished commutator. In some cases, more severe, it will take several trips for the commutator to completely recover. That recovery, incidentally, is the mark of a very desirable traction brush.

Commutators of locomotives operating alternately in freight and passenger service tell the story of the latest run. A heavy freight movement will in some cases remove a highly polished film from the commutator and a later smooth passenger run without incident will restore an even film. This is due largely to the amount of current flow.

On inspection, the condition of the commutator acts as a guide to detect trouble in the motor, the generator or anywhere in the transmission system. Almost all troubles are written on the face of the commutator.

Maintenance

There is no maintenance of the brush itself. It is either good or bad, which determines whether it is left to run or be discarded.

The maintenance in connection with brush operation is in the brushholders, the spring tension and the commutator. Brushholders should be set as prescribed by the electrical manufacturer. It is ⅛ in. from the commutator surface. This is important to the stability of the brush, and that clearance should be maintained, when commutators are turned.

On inspection of brushholders in the back shop, it is desirable that the brushholder spring pin be checked for wear and that the pin itself has not worn into the softer material of the cast brushholder. This happens on some of the older equipment. The effect of this condition on brush operation is to set the finger on the top of the brush at an angle which does not permit equal distribution of pressure on each half of the split motor brushes.

The brushholder pockets should be maintained free from burrs, beads or blistered due to flash-overs. On the older equipment, the clearance in the brushholder pockets should be checked in back-shop inspection.

The brushes themselves are manufactured to a total tolerance of .004 in. on the thickness dimension. This should permit .004-in. clearance between the maximum size brush and the minimum size holder. Worn holders cause tilting of the brushes in the boxes which, particularly in radial operation on reversing units, can cause chipped brushes.

Brushholder spring tension should be adjusted during back shop inspection to the specification of the electrical manufacturer. Unequal spring tension causes uneven brush wear and in extreme cases wearing of the commutators in paths due to excessive current flow in that path.

Dollars and cents costs of brush operation can in many cases be reduced by the establishment of a standard dimension at which brushes are to be removed for wear.

This depends largely on the service miles between motor inspections. Units operating in short runs can utilize much more of the brush than those running from one to four thousand miles between inspections. In the latter cases the inspectors are justified in removing a brush which is nearly worn out rather than to risk trouble on the road due to short brushes. On short runs, however, the established maximum should be obtained.

Split Brushes

Split brushes have been in use on stationary machines for some time. During the past few years, they have been applied to traction applications replacing the one-piece brush. Their use has been justified especially on high speed commutators for two outstanding reasons, both having to do with commutation.

The use of two sections provides an electrical resistance between sections which is a distinct advantage in the damping of circulating currents. It has been found also that the two sections will maintain more intimate contact with the commutator and provide more points of contact for efficiency of current collection. Their use on some machines has considerably improved commutator conditions over those with the one piece brush and has resulted in lower commutator maintenance costs.

Slow speed switching equipment has not been affected so seriously and some railroads continue to use the less-expensive, one-piece brush with good results.

Sanding of Brushes

Generally speaking, the sanding of brushes is desirable. This is particularly true on low-voltage units where the generator output or motor speed is seriously affected until the brushes have become well seated. On traction equipment however, this practice is inconvenient.

On new equipment, brushes have been run in to a satisfactory seat at the plant of the manufacturer in the final testing of the equipment. The other occasion for applying complete new sets of brushes is in the back shop where again the assembled motor is usually run in its own bearings and the brushes at least partially seated. However, on railroads no difficulty has resulted from the installation of new unseated brushes.

Commutator Film

Occasionally, brushes are judged by the complexion of the film they produce on the collecting surface in such general terms as "a nice chocolate color," or "darker than I like to see it," or "not enough polish," etc. This type of generalizing has on some occasions graduated into the class of "it looks like a high friction film to me" or "there is too much—or too little film."

From the practical point of view, a commutator or ring surface with a polish is highly desirable and to be preferred over those which are dull.

We know that film on the collecting surface is the result of the rubbing action between it and the brush. We know that the nature of that film is determined by a considerable number of factors among which are the material of the collecting surface, the characteristics of the brush material, the current flow, the quality of commutation, the humidity, impurities in the air including dust, chemical fumes, etc.

We also know that films change readily with changes in these conditions, but we do not know as yet, how to reconstruct one specific film even under controlled conditions of laboratory experimentation.

As to film, the most satisfactory brush is that which under normal conditions will provide one,—and which will replenish it, should it be removed due to momentary distress in commutation.

Brush and Commutator Wear

There are two distinct kinds of brush wear on all applications. These are mechanical wear, that is, wear due to abrasion, and electrical wear. Given a good commutator, concentric and smooth, mechanical brush wear is a very small percentage of total wear. The major cause for brush wear is the disintegration of the brush material due to arcing between the brush and the commutator.

The application of too heavy spring tension will wear commutators. The application of light tension will cause bouncing of the brushes and wear of the commutator due to arcing. Particles of hard dirt under the faces of the brushes is another cause for commutator wear particularly on railroad equipment.

(*Continued on page 742*)

Erie's Radiotelephone System

All communication equipment is operated on 110-volt a.c., with 4-kw., 32-volt axle-driven generators supplying caboose power

To increase the efficiency and safety of train operation, the Erie has made a large space radio installation on 347 miles of main line between Marion, Ohio, and Salamanca, N. Y. Fourteen wayside offices, 15 cabooses and 16 Diesel-electric locomotives are included in the initial installation. The locomotives are the double-end type, with complete radio equipment in each cab, thus totaling 32 independent sets of locomotive radio apparatus now in service. One of the outstanding features of the installation is the provision for radio communication between adjacent radio equipped wayside offices in either direction in case sleet causes damage to pole lines. When such damage occurs and interrupts the dispatcher's telephone circuit (wire), which extends over a division, his means of dispatching trains may be restored in the emergency by establishing a radio link to patch the interrupted section. In the event of wire line prostration over greater areas, an emergency radio relay communications network is available for the control of traffic along the right of way.

This project culminates nearly two years of extensive study and experimentation on the part of the railroad's communications and operating departments, and the Farnsworth Television & Radio Corporation. Extension of the system is in progress eastward from Salamanca, N. Y., to Jersey City, N. J., which will cover an additional 537 miles of main line trackage. Thirty-seven wayside offices, 20 cabooses and 13 Diesel-electric locomotives, each with an independent radio set in the cab at each end (26 locomotive radio sets) are included in this project. When completed in 1949, the radio communication system will be in operation over 884 miles from Jersey City to Marion, or approximately 85 per cent of the Erie's main line between Jersey City and Chicago. It is believed that this will be the most extensive radio communication system on any railroad in the United States.

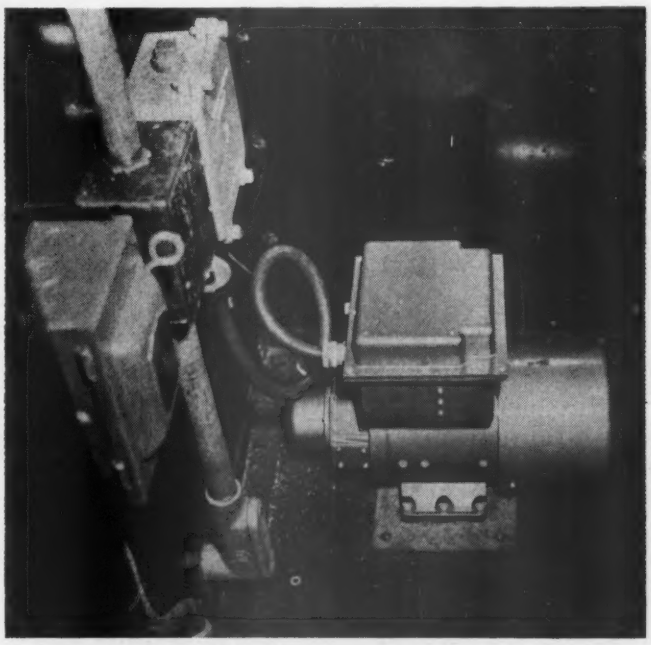
The installation between Marion and Salamanca involves three divisions—the Kent, Mahoning and Meadville—which were selected first because they present all the complex problems encountered in freight and passenger train operations—heavy grades, curves, single and multiple track, and weather conditions. The Kent division extends 116 miles east from Marion to Kent, Ohio; the Mahoning division 129 miles to Meadville, Pa.; and the Meadville division 102 miles to Salamanca. The dispatchers for these divisions are located at Marion, Youngstown and Salamanca, respectively.

Double track is in service for 277 miles of the 347-mile section between Marion and Salamanca, via Youngstown, and single track for the remaining 70 miles—28 miles between Leavittsburg and Pymatuning, 6 miles between Youngstown and Pymatuning, 26 miles between Shenango, Pa., and Meadville, and 10 miles between Waterboro, N. Y., and "RH" tower. Between Marion and Salamanca, the railroad crosses five river valleys, in which severe fog presents poor visibility conditions during some seasons of the year. The maximum ascending grade in either direction in the territory is 1.1 per cent. Train movements are governed by time table, train orders and automatic block or centralized traffic control.

Radio telephone equipment as used by a trainman in the caboose cupola

Traffic

The traffic in each direction daily between Marion and Salamanca averages one express, three passenger and twelve freight trains, and extras as required. Thus the total number of trains in both directions averages about 35. The maximum tonnage handled ranges up to approximately 7,000 tons, with the exception of manifest

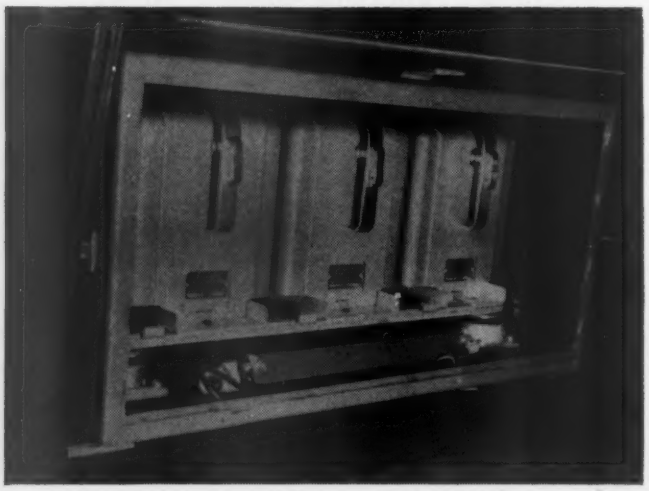


The rotary converter which operated from the 32-volt power in the caboose and produces 110-volt, 60-cycle, a.c. power for the radio set

freight trains, which range up to about 5,500 tons. Of the 16 radio-equipped Diesel-electric locomotives used in handling the traffic, 9 are assigned to freight service and 7 to passenger service.

Space Radio Throughout

Low-powered 15-watt space radio equipment, operating in the mobile units under the assigned call letters, WSVD, is used for all communication between the head and rear



Transmitter, power supply and receiver units—These are plug-in devices which are removed for servicing

ends of trains, trains and wayside stations, trains within the radio range, and between wayside stations. Crews of both freight and passenger trains are to be supplied with lightweight walkie-talkie radios, so that they can, when on foot beside or at the ends of trains, talk directly to their conductors or other crew members, or to the crews of other nearby radio-equipped trains or 24-hour offices.

The equipment in each locomotive cab consists of a radio control unit and attached Aviometer type hand set on the engineer's side, and a loudspeaker on both the engineer's and fireman's side. A similar control unit, hand set and 15-ohm Racon loudspeaker are located in the center of each caboose in a manner as to be conveniently reached from the floor or cupola. A desk-type control unit with a built-in loudspeaker, and a separate Western Electric Type F-3 handset are in service at each wayside control office. In either instance, the push-to-talk switch is pressed when placing a call and released for the reply to come in over the loudspeaker.

The system's V.H.F. 15-watt transmitters and receivers are dual frequency units, with the Erie's end-to-end and train-to-wayside frequencies (160.05 mc. and 159.09 mc. respectively) utilized. The walkie-talkie units operate on the point-to-train frequency.

Fourteen Wayside Offices

There are fourteen 24-hour wayside offices where radio control equipment was installed, spaced at approximately even distances to give coverage over the entire 347-mile route between Marion and Salamanca. Beginning at the west end, they include Marion, Mansfield, Creston, Silver Creek, Kent, Leavittsburg, and Youngstown, Ohio; Pymantuning, Meadville, Cambridge Springs, and Corry, Pa.; and Falconer Junction (Jamestown), Randolph and Salamanca, N. Y.

The transmitters and antennas controlled by nine of the wayside offices are located right at those offices. On the other hand, however, the transmitters and antennas controlled by five of the offices are located several miles away, because of irregular terrain.

Wayside and mobile stations are normally tuned to the point-to-train frequency. When the train-to-wayside frequency is in use, other mobile units within range can use the end-to-end frequency for intra-train or inter-train communication without causing interference. The mobile station operator must depress a button on the control panel to use the end-to-end frequency. When the user of a mobile circuit is through using the end-to-end frequency, the transmitters and receivers automatically readjust themselves to the train-to-wayside frequency, thus eliminating the possibility of human error, which might result in mobile units not being on the train-to-wayside frequency when a 24-hour office had to reach a train within radio range of the wayside station calling.

The dispatcher on any of the three divisions can, when necessary, talk to the conductor, engineer or other crew

The caboose generator regulator is the same as those used for car lighting generators

member on any train under his jurisdiction. To do so, he calls the 24-hour operator's office nearest to the train on the dispatching telephone circuit. The operator then connects the dispatcher's circuit to the radio system and the necessary conversation may be carried on.

Caboose and Locomotive Equipment

The radio transmitter, receiver and a power rectifier on each caboose are in a sheet-metal case under one of the seats. On the locomotives, this equipment was installed similarly in the nose of each end, and new Diesel-electric locomotives, now on order, will be delivered already radio-equipped.

All radio equipment and control units are the unitized plug-in type, so that defective units may be replaced in the field in a matter of seconds, and so that routine maintenance checks may be made with a minimum amount of effort. Each transmitter, receiver, power rectifier, con-

trol unit and power converter is mounted on separate chassis. While only one frequency is used by wayside stations, dual-frequency transmitters and receivers are in service at all wayside points, so that they can be replaced by any mobile transmitter and receiver or vice versa. Weight of all the equipment is minimized by use of aluminum chassis and covers, which also eliminate any chances of corrosion. All wiring on the cabooses and locomotives is in steel conduit with Crouse-Hinds fittings.

Wayside and Mobile Antennas

The antennas at the wayside stations are the ½-wave type mounted 80 to 85 ft. in the air atop guyed wood poles set in the ground about 9 ft. The antennas on the cabooses and locomotives are known as the "firecracker" type because of their resemblance thereto. On the locomotives and cabooses the antenna is connected to the radio equipment by 52-ohm coaxial cable, which is also the case at the wayside transmitting stations except where a cable in excess of 50 ft. in length is required and, in which case, heavier type coaxial cable is used.

The main element of the wayside antennas is grounded so that in the event that it is struck by lightning, a minimum risk to equipment and personnel is involved. The antennas on the mobile units, likewise, include this feature, so that electrical charges will not accumulate on them and, thus, become a hazard to operating or service employees. The mobile antennas are low in height,—less than 12 in.,—so that bridge, tunnel, shop and other clearances can be passed.

Power Supply

All mobile and fixed station radio equipment is operated on 110 volts a.c. Commercial a.c. is used to power the wayside radio transmitting, receiving and control equipment. Power for operation of the equipment on each caboose is furnished, through a 110-volt a.c. Eicor regulated rotary converter, by 25 cells of Edison Type-AH6 nickel-iron-alkaline storage battery, rated at 32 volts, 225 amp.-hr., on charge from a 4-kw. Safety Car Heating & Lighting Company belt-driven axle-generator. The converter is located separately from the radio equipment in a ventilated compartment inside the center of the car, and the storage battery is arranged in 5 trays, including 5 cells each, in a steel battery box under the caboose. Power connections between the batteries and radio equipment are in heavy shielded conductors, the shield of which is grounded, to minimize induction of noise.

On the locomotives, power is obtained from the locomotive storage battery, also through a 110-volt, 2.7-amp. 60-cycle a.c. Eicor regulated rotary converter, located in the nose of the locomotive with the radio equipment. Walkie-talkie sets are powered by a small Willard lead-acid type storage battery, with provision for charging facilities at four division points,—Marion, Kent, Meadville and Salamanca.

The generators and the batteries assembled in boxes are suspended from the underframes. Generator regulating equipment and load-voltage regulators are installed in lockers inside the cabooses. Generators, batteries and regulating equipment have been retired from carlighting service in passenger train cars.

Most of the batteries are 22 to 25 years old, although some are a few years older. They test 80 per cent or more of their rated capacity (225 amp.-hr. at the 5-hour rate). However, the load demands are relatively light, the only load being the rotary converter which has an input rating of 16.6 amp. when operating at capacity, compared to the normal rate, 45 amp., of the A6 cell. The present battery capacity, therefore, is sufficient to provide an operating reserve of approximately 15 hours when the maximum load is continuously connected.

The 4-kw. generators have ample capacity to carry the

Power for the train radio system is furnished by an axle-driven generator and batteries which are house din a cabinet under the floor of the caboose

present loads and, at the same time, to charge the batteries at an average of the normal rate. Since the maximum generator voltage exceeds the maximum d.c. voltage rating of the rotary converter (40 volts), the output of the generator-battery system is supplied to the rotary converter through a load-voltage regulator, set to a value of approximately 32 volts, as a means of improving the overall regulation. The regulation incorporated in the rotary converter consists of a centrifugal governor which acts to increase the field strength by reducing resistance in series with it when the speed increases and conversely when the speed decreases, thus holding the speed substantially constant.

The generator-battery system was selected as caboose power supply primarily because of the dependability and economy of operation it has demonstrated on passenger train cars. Contributing to its operating economy is the fact that it is an all-electric system and therefore, can be maintained by the personnel of the electrical department.

Facilities for inspecting, flushing and, if necessary, yard-charging the batteries have been provided in Marion yards. The equipment for yard-charging consists of a motor-generator having a d.c. rating of 200 amp. at 55 volts, which will charge four batteries at an average of the full normal rate, or a smaller number at boost rates. The radio cabooses are scheduled to be brought to Marion yards for inspection at intervals averaging every ten days, but not exceeding two weeks.

To facilitate converter service on quick-turn-about Diesel-electric motive power, special plug-in, quick-disconnect plugs permit the replacement of converters in a matter of a few minutes, so that routine, as well as important converter service may be performed off the locomotives. Similar plugs are in service with the converters on the cabooses.

Maintenance of Equipment

Because all units of the system are the unitized plug-in type, major service work is performed at a single maintenance shop at Marion. Since all mainline Diesel-electric locomotives operating over the three radio-equipped divisions are serviced at Marion, opportunity is provided to inspect all mobile equipment regularly. When equipment failures occur elsewhere, local communications repairmen change out equipment with spare units which are part of their regular supplies, and ship back the defective equipment to Marion for repair. Shipping cases are provided for this purpose.

The fixed station units on the three divisions are serviced and maintained by the division communications maintainers, subject to general technical supervision of the chief of the Marion radio shop. All these employees are sent to Fort Wayne, Ind., where they receive a week's training course in the manufacturer's factory to acquaint them with equipment and service procedures.

This project was planned and installed by the Erie forces under the direction of F. H. Menagh, superintendent of communications. The major items of radio communication equipment were furnished by the Farnsworth Television & Radio Corporation.

As part of the project now under way for extending the radio system east from Salamanca to Jersey City, an additional 20 caboose are being equipped with generators, batteries, converters and radio instruments similar to the equipment on the first 15. Similar facilities for inspecting and maintaining the batteries are to be established at Hornell, N. Y. It is expected that the system will be extended west from Marion to Chicago in the near future, thus covering entirely the Erie's Chicago-New York main line.

Brushes for Diesel-Electrics

(*Continued from page* 738)

The combination of brushes and commutators is the heart of the direct current motor or generator. Misapplication of the brush can be, and sometimes is responsible for undesirable commutator conditions.

An improperly applied brush can cause smutting of the commutator bars, blackening of the entire surface of the commutator and burring of the bar edges, all of which are to be classed as electrical brush faults.

Mechanically, a mis-applied brush can thread the commutator and groove it to an extent requiring grinding or turning which are the really expensive items of maintenance of electrical equipment.

It is equally true that the condition of the commutator has just as much bearing on the overall performance of the unit in traction service as does the brush and the brushholder. The art of commutator maintenance, particularly for high speed equipment is just as important as the building of the commutators in the plant of the manufacturer.

It is important, therefore, that in our consideration of brush performance, we give adequate attention to the commutator and its influence on general operation.

The illustration is an oscillograph record which shows the effect of a commutator having a high bar and two flat spots. The test equipment here consisted of a commutator 10 in. in diameter, having 100 segments with a pitch of .314 in. The speed varied from 1700 to 3700 r.p.m. and the peripheral speed 4450 to 9700 ft. per min. The current varied from 35 amp. to 47 amp, per sq. in. The brush was 1 in. wide and ¾ in. thick.

The method adopted in these tests was to divide the brush into portions circumferentially. The two halves of the brush were insulated from each other and from the brush box but rigidly stuck together to ride as a single brush.

In order to imitate conditions that are often met in operating practice, commutator segment No. 1 was raised approximately .0005 in to provide a high bar. Segments No. 52 and No. 53 and also segments No. 72 and No. 75 were rubbed down approximately .0005 in. to provide flat spots of two and four bars respectively.

By means of an oscillograph the current in each half of the brush was determined and the contact drop measured. It will be noted on this oscillogram that when the brush comes in contact with the high No. 1 segment, the voltage drop increases about 500 per cent and that the current is divided between the two halves of the brush in accordance with the manner in which the brush makes contact with the commutator.

At the high bar the brush leaves the commutator completely for about three segments. The leaving edge then touches the commutator and bounces off, the entering edge touches and bounces off and the same cycle is repeated at shorter intervals.

Stability of contact drop and current collection does not quite recover to normal when the brush hits the low bars and a similar bouncing of the brush takes place.

The effect seen in these oscillograms are those of a stationary test unit mounted on a solid bed plate and the vibration is at a minimum except for that provided by the high and low spots on the commutator. Locomotive operation with its often severe vibration and with the higher voltage and currents, provides a far greater effect.

The interruption of the brush-commutator circuit draws arcs which are often of sufficient intensity to burn the commutator segments as well as disintegrate the brush material.

Black Lighting for Cab Dials

By M. D. Henshaw* and F. H. Catlin†

Reading of Diesel-electric locomotive dials made easy with no interference to the engineman's ability to see ahead at night

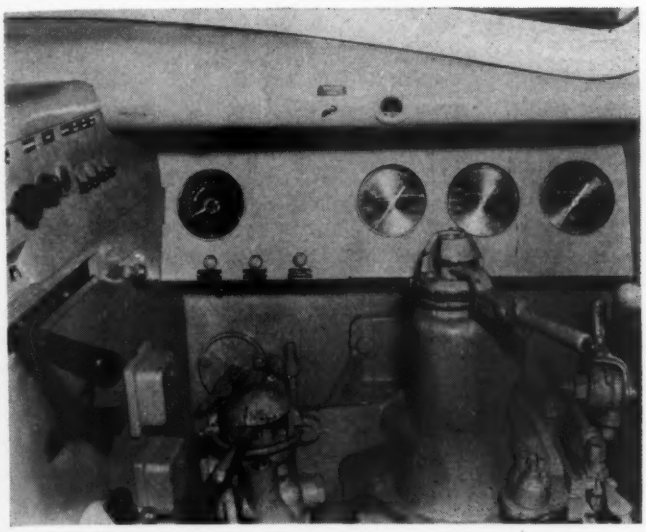


Fig. 1—Diesel-electric locomotive instrument panel arranged for ultraviolet illumination

THE illumination of instruments in the operating cabs of Diesel-electric locomotives has undergone developments in recent years which have advanced it to the point where it equals, if not surpasses, the best practice in other branches of the transportation industry, such as automotive and aviation.

Incandescent Systems

The original illumination methods copied those used for many years on steam locomotives. Standard incandescent lamps were mounted in housings in front of the instruments. Slotted apertures were used to prevent too wide a light spread. When it became desirable to modernize the operating cab, the same lamps were mounted behind the instrument panel, and slots were cut in the instrument rims to permit light to reach the scale plates.

The size, amount of heat liberated, and access means necessary, have always made it impractical to mount standard-size incandescent lamp bulbs inside of the instruments themselves. One modern development has been the mounting of miniature-size bulbs inside the instrument cases. The instrument and gauge manufacturers have developed the special cases required.

Incandescent illumination has the advantages of simplicity, low cost, and easy maintenance. With the older methods of light transmission, the illumination of the instruments was relatively inadequate, and difficulty was experienced in preventing glare from the instrument scale plate itself. These disadvantages have been practically eliminated in the latest designs mentioned above.

Ultraviolet Systems

During World War II a system of ultraviolet illumination was developed for aircraft instruments making use of invisible or "black" light, previously considered a laboratory curiosity but sometimes used on the theatre stage for novel effects.

Night fighting and bombing required the adaptation of the pilots' eyes to utter darkness, yet frequent instrument reference was necessary without destroying this dark adaptation. The ultraviolet system proved equal to these unusual requirements. Somewhat similar requirements are encountered in locomotive operation, so the same principle has been adapted to the illumination of instruments on some Diesel-electric locomotives.

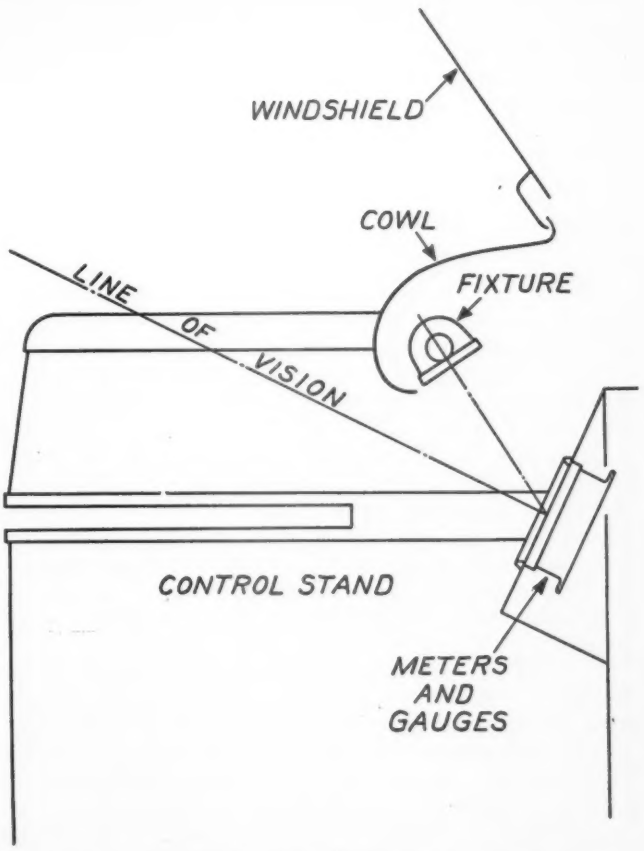


Fig. 2—Diagrammatic sketch of ultraviolet lighting arrangement for Diesel-electric locomotive instrument panel

The principles involved are simple. The instrument pointers and scale-plate figures are coated with a paint which glows or fluoresces in the dark while subjected to ultraviolet light. This paint is different from the phosphorescent paints used on watches and clocks which glow continuously in the dark after having been excited or energized by a light source rich in ultraviolet. These

*Control Engineering Division, Erie Works, General Electric Company.
†Works Laboratory, Erie Works, General Electric Company.

Fig. 3 — Appearance of locomotive instrument panel under ultraviolet light

fluorescent paints are available in a variety of brilliant colors. Most of the paints used on the instruments have the same color in daylight as under ultraviolet light.

The instrument scale-plates are painted a dull black to accentuate the pointer and figures and to prevent daytime glare. Except for the special painting the instruments are otherwise standard in all respects.

The ultraviolet light source is the 4-watt RP12 "Black Light" lamp developed by the Lamp Department of the General Electric Company for aircraft use on 24-volt, d.c. circuits. With special circuit arrangements the lamps can be operated on the 75-volt d.c. battery circuit of the locomotive. The lamp is a double-contact, bayonet-base type of the same physical size and shape as the standard automotive headlight lamp used prior to the development of the sealed-beam headlight unit. The bayonet pins are offset to prevent the bulb being improperly inserted in the socket.

The RP-12 lamp emits energy in the ultraviolet band of the light spectrum, with sufficient spread into the visible range to appear to the eye as a light bluish color. The visible light is filtered out by a special glass filter built into the lighting fixture.

A four- or five-unit instrument panel is illuminated by two lamps housed in a reflector-type fixture mounted in the locomotive cowl above and in front of the instruments. This cowl is shown at the top of Fig. 1. The filter glasses are removable for access to the lamps and sockets.

Although the filtered ultraviolet light is invisible to the human eye as light, it does produce a fluorescence of the eyeball resulting in the sensation of a visible purple haze. Since all light, visible and invisible, obeys the laws of reflection, precautions are taken to arrange the angle of light projection onto the instruments so as to avoid any reflection to the operator's eyes as indicated diagrammatically in Fig. 2.

The RP-12 lamp is of the fluorescent type. A cathode heater is brought to incandescence by a momentary contact on the manual starting switch. When this contact is released, an arc strikes between the anode and cathode and continues until the circuit is opened. The lamp has excellent starting and operating characteristics over a wide range of voltages and temperatures. Its rugged construction makes it highly resistant to locomotive shock and vibration.

A series resistor is used as a ballast in the same manner as domestic fluorescent lamp ballasts. The resistor is mounted as part of the manual starter switch. Since the RP-12 lamp will operate over a wide voltage range, dimming control is frequently built into the starter switch so that the individual operator can select his own illumination level.

Service Experience

Service experience on several hundred locomotives has demonstrated the effectiveness of the ultraviolet system for locomotive use. Enginemen have accepted it and many have been outspoken in their praise.

The absence of visible light in the cab coupled with the excellent legibility of the instrument markings permits instrument reading at a glance. This is advantageous under adverse conditions such as exist during a dark, rainy night when road-bed visibility is poor and distant vision must be maintained for safety. The striking color combinations used on the instrument color bands assist in making quick and accurate readings and present a pleasing appearance.

Figure 3 shows a photograph of a locomotive panel with actual ultraviolet illumination of the instruments. Note that only the pointers and figures are visible.

The dimming control provided in the original installations is not widely used. A few enginemen do adjust the illumination level to suit their personal liking, but in most cases maximum intensity is used.

The fluorescent paints were chosen to meet U.S. Air Corps specifications.

Special identification is required for instruments with ultraviolet treated dials and pointers since in the daylight they appear the same as ordinary instruments.

* * *

A meter-gauge Diesel-electric switching type locomotive in mixed train service on the Parana Santa-Catarina Railroad of Brazil—The locomotive is one of eight Alco-G. E., 70-ton units recently placed in service by this railroad

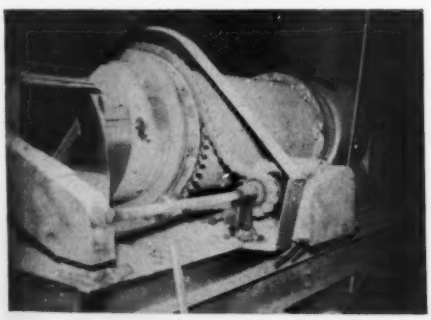
NEW DEVICES

Sand-Drying Uniti

The Mines Equipment Company, St. Louis, Mo., is introducing into the railroad field for use in drying locomotive sand, a unit known as the Type A-8 direct-heat,rotary dryer-screener, which, it is said, can automatically dry and screen sand at the rate of two to three tons per hour. It is driven by an electric motor and utilizes, for drying, the heat of an open flame produced by the combustion of either oil or gas.

Essentially, the equipment consists of a feed hopper; a rotating-drum dryer fitted with baffle plate and a stack, and, at the discharge end, a rotating screen and a combustion chamber. The entire unit is mounted on a structural steel channel frame and, when properly installed, is situated in such a manner that the discharge end is 8 in. lower than the feed end.

Wet material is fed into the unit by gravity through the feed hopper, from which it is carried into the drum dryer by a screw conveyor. As the drum rotates the material showers off its baffle plates and, at the same time, is subjected to the direct heat of the flame. Each revolution brings the material closer to the rotating screen

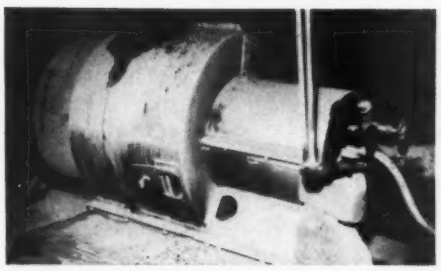


The Mines sand dryer as seen from the discharge end

and also to the source of the heat. As the sand in a dried condition reaches the rotating screen, the latter separates the fine from the coarse material and both are discharged automatically through separate openings.

The stack is located at the feed end of the heating drum, permitting an arrangement whereby the incoming sand in the hopper is preheated by contatct with the hot outer walls of the stack. As furnished, the stack terminates in a 10-in. collar to facilitate extension (by the user) to meet installation requirements. The combustion chamber has a lining of insulating brick between the outside metal enclosure and the circular firebrick interior.

The rotary dryer drum and the feed-hopper screw are roller-chain-driven by a 2-hp. 220-440-volt, 3-phase, 60-cycle, totally enclosed, fan-cooled, ball-bearing motor. Power is transmitted through a right-angle worm



Feed hopper and rotating drum of the Mines locomotive sand-drying unit

reducer (25-to-1 ratio) connected to the roller-chain drive shaft through a flexible-type coupling.

These dryers can be supplied with any one of three different heating arrangements, viz, a low-pressure oil-burner and blower directly driven by a 1-hp. motor; a high-pressure oil-burner for operation with compressed air, or a gas burner using either natural or manufactured gas. To permit gravity feeding if oil is used, the oil supply tank must be situated not less than 15 ft. above the burner. If this arrangement is not practicable, an oil pump must be used. The unit is 13 ft. 8 in. long, 4 ft. 6 in. wide; 3 ft. 3 in. high and weighs approxiately 4,500 lb.

Air Reduction Introduces New Welding Process

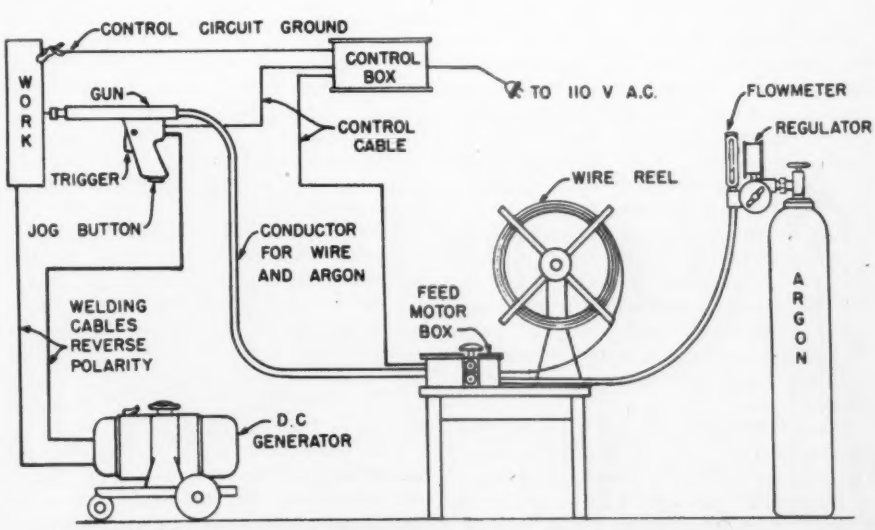
The Air Reduction Sales Company, 60 E. 42 st., New York, introduced a new welding process to industry at the opening of the National Metal Show on October 25 at Philadelphia. This process, the feature of the Air Reduction exhibit, is known as the "Aircomatic" process. It may be used for welding heavy sections of aluminum and aluminum alloys at wire feed speeds ranging from 100 to 300 inches per minute, permitting deposition rates far exceeding those attained by usual welding methods.

A gas-shielded, metal arc method of welding, the Aircomatic process consists of feeding a consumable wire through a manually-operated welding "gun." The metals being welded are shielded from the air by an inert gas. It is anticipated that this new process will have an immediate and widespread application throughout industry. According to the manufacturer, the manual units are now coming off the production line and will be generally available by the end of this year. Automatic equipment employing the same principles is also under development at this time.

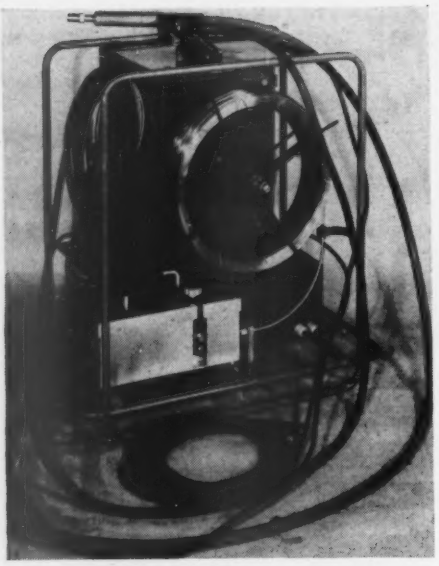
The application of the process to metals other than aluminum and aluminum alloys is now under development in Air Reduction's research laboratory.

From an engineering point of view the problems surrounding this new approach have been many, involving new concepts of a combination of factors including current density, gas shielding and filler-wire feed speeds. Briefly, this new process involves feeding a consumable wire, which replaces the conventional non-consumable tungsten electrode, through the barrel of the welding gun. This filler metal carries welding current and an arc is maintained between the end of the wire and the work. Power is supplied from a standard d.c. welding generator.

With the Aircomatic unit, welding of aluminum may be performed in all positions, namely, flat, horizontal, vertical and overhead. All of the standard joint designs may be welded in these positions. All the facility associated with metal-arc welding of steel is made available by this process, plus the advantages of a high deposition rate resulting in continuous filler-metal feed and the absence of slag. According to Air Reduction, as far as it is now known, this is the first time that continuous wire feed has been



Schematic diagram of Aircomatic equipment for welding aluminum



The Aircomatic gun, wire reel, feed motor box and control box for the Aircomatic process

employed for practical welding in the vertical and overhead positions.

Argon has been found to be a satisfactory shielding gas for aluminum welding. The welding grade of argon currently supplied for Heliwelding is suitable.

For the welding of aluminum, as currently provided in this process, only three sizes of filler metal are needed, 3/64 in., 1/16 in. and 3/32 in. With these filler metal sizes the overall current range is 70-450 amperes which permits welding of metal thicknesses from ⅛ in. up to 2 in. and more.

The component parts of the Aircomatic unit are the welding "gun," gas (argon) hose, concentric with which is the metallic tube for conveying the welding wire, a three-conductor control cable, feed motor box, control box and wire reel. The welding "gun," which resembles an automatic pistol, is equipped with a trigger which readies the unit for welding and a "jog button" for feeding wire when not welding. To start welding, the trigger is depressed. It can be locked in the "on" position by means of a button. This starts the flow of shielding gas. Next, the electrode, which should project ½ to ¾ in. from the gas nozzle (hence, the "jog button"), is scratched on the work. When arc voltage is established, the controls operate to energize the feed motor and deliver filler metal. The diagram shows the general paths of the argon shielding gas and welding current.

For welding, the gun is held so that it points ahead in the direction of welding. To terminate a weld when no welding current contactor is used, the arc is easily broken with a quick snap. If a contactor is used in the circuit, the operator need only release the locked trigger.

The advantages of this unique welding process include: (1)—A manual welding process with the essential features of automatic welding; (2)—continuous deposition of filler metal at high rates; (3)—manual manipulation of an automatic process for welding in a vertical and overhead position; (4)—high quality weld metal deposits; (5)—minimum edge preparation owing to deep penetration; (6)—ability to weld heavy sections with little or no preheat; (7)—no flux required; slag removal eliminated, and (8)—visible arc; no blind welding.

Motorgears

Fairbanks, Morse & Co., Chicago, has announced that its "pancake," axial air gap motor is now available as a motor reducer.

Available in ratings from ¾ to 10 hp., the units are symmetrical in design with no separate right-hand or left-hand assemblies. The motor may also be removed from the gear housing and run separately.

The Motorgear employs two ratios of single helical gears with hardened and accurately shaved teeth arranged in simple gear trains. It does not employ planetary gearing.

Due to the shape and small dimensions of the motor, the Motorgear is exceptionally compact

The motor and gear shafts are parallel, with the centerline of the motor coinciding with the centerline of the low-speed shaft. The motor shaft rotates on ball bearings, while the gear shafts are mounted on tapered roller bearings. The high speed pinion, mounted on the motor shaft extension close to a double row ball bearing, reduced deflection of this overhung pinion to a negligible minimum. The bearings on the low speed shaft are over-size to allow for a generous amount of outboard pull from a sprocket, gear or pulley that may be mounted on this shaft.

The gear housing is a one-piece casting with all four feet included in the same casting. Consequently there are no joints between the feet that might have a tendency to leak from the strain of tightening down the foot bolts. Being finished together on the same casting, the bottom of the four feet are always in line.

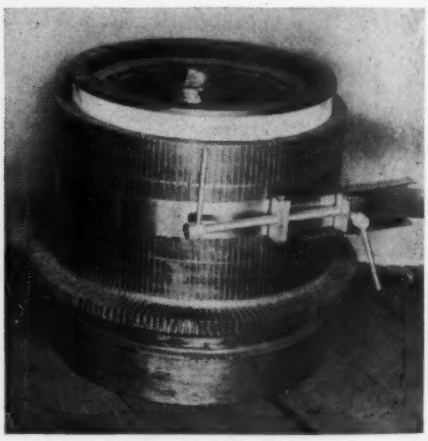
The gear is suitable for horizontal mounting, preferably on a level floor, but provisions can be made for wall, ceiling or angle mounting, provided the shafts remain horizontal.

Clamps for Armature Winding

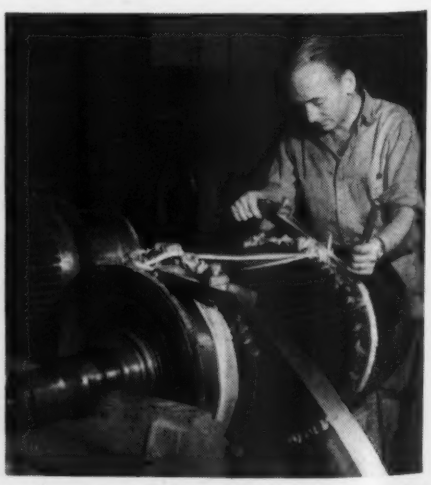
Multi-purpose clamps for armature repair work are now being made by Marman Products Co., Inc., Inglewood, Calif. The clamps are used to pull coils into place when re-winding armatures. Common practice is to use a wire banding machine to accomplish this purpose. By wrapping the Multi-purpose clamp around each layer of coils, tightening locking device and taking up on the screw, intense pressure can be applied to force coils into position for final banding. It is estimated by users that as much as six hours are saved on large jobs.

The clamp is also used in a similar manner to hold commutator segments while assembling and processing. This again does away with the necessity of using a banding machine and facilitates the operation.

Its design also permits clamping of many different shapes and objects. A large diametrical take-up range is provided and pressure can be instantly released by backing off the locking screw one-half turn. It consists of a tough, interchangeable, stainless steel strap furnished in 1½- to 2-in. width of any desired length, a square swivel assembly and take-up and locking screws of cold-rolled steel.



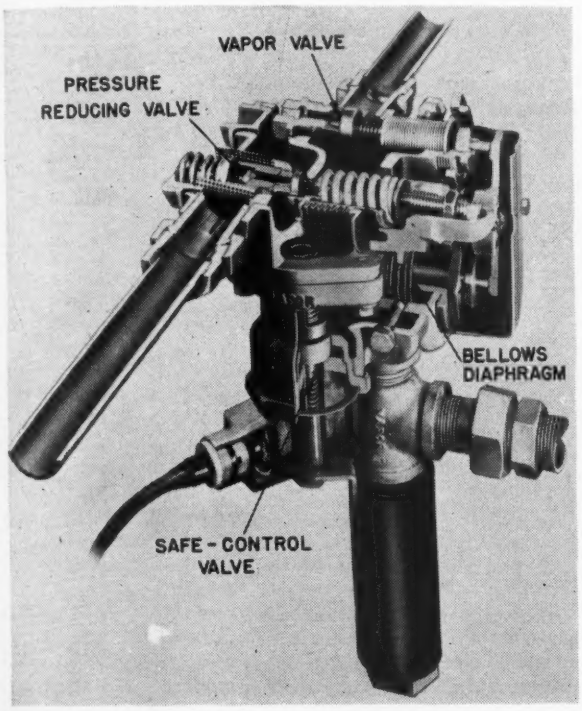
A Marman clamp as used to hold an armature assembly



Two of the clamps as used for armature winding

Regulators for Steam-Heat Loops

A series of regulators to maintain constant steam pressure in the steam-heat loops that supply steam to passenger-car radiation has been introduced by the Vapor Heating Corporation, 4501 West 16th street, Chicago 23. Known as the Safe-Control regulators, these devices are located between the steam train line and each of the supply loops to control the flow and the pressure of the steam in the loop. The valve construction allows only enough steam to flow through the unit to fill the loop at the desired pressure and to replace the steam used by the radiation. In this way accurate control over the steam pressure in the loop is maintained and the circulation of steam in excess of that required for heating is avoided.



Cutaway view of the Vaper Safe-Control regulator for maintaining a constant steam pressure in a passenger-car radiation supply loop

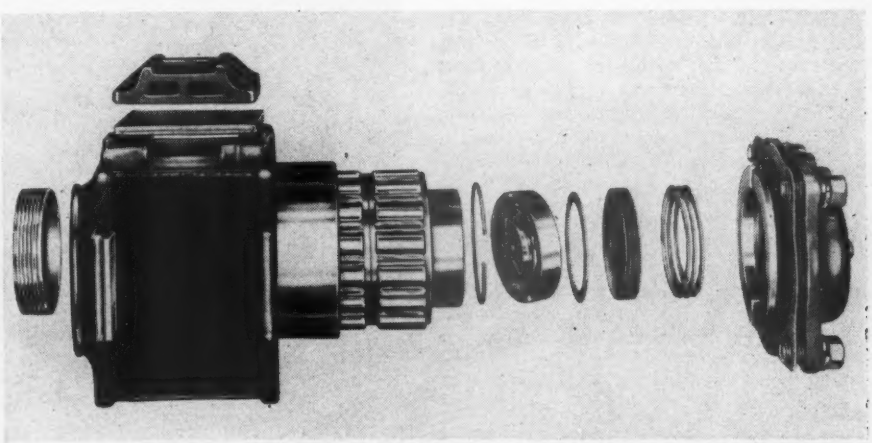
Steam entering the regulator at train-line pressure is reduced to 50 lb. per sq. in. by the pressure-reducing valve. It is further reduced to 8 or 12 lb. per sq. in., depending on the style of regulator, by the vapor valve as the steam leaves the regulator to enter the loop. A Safe-Control valve prevents steam from entering the loop at more than the desired pressure by functioning as a relief valve. When the desired pressure is reached in the loop, steam opens this valve and is jetted onto a liquid-filled, bellows-type diaphragm. The diaphragm expands from the heat of the steam and, in expanding, moves a pivoted operating arm which closes the vapor valve to stop further flow of steam into the supply loop. As the diaphragm cools it contracts. A spring reopens the vapor valve and again allows the steam to flow into the loop.

In this series of regulators, Nos. 955 and 956 are designed to maintain a 12-lb. pressure in the steam supply loop; Nos. 958 and 959 maintain 8 lb. Both pressure styles of these regulators are equipped with a solenoid that operates the Safe-Control feature to keep steam out of the loop during cooling or to place a regulator under the control of a special thermostat to maintain a minimum amount of heat in a car during layovers.

Journal Box Grease Lubrication

A combination ball- and roller-bearing journal box designed for grease lubrication exclusively has been announced by the Fafnir Bearing Company, New Britain, Conn. Straight roller bearings are used in this box to support the radial load, while the lateral thrust is taken by a single-row ball bearing near the outside end of the box.

Among the advantages said to result from grease lubrication are reduced maintenance cost through longer periods between relubrications and longer bearing life due to greater cleanliness. Greater protection against corrosion during inactive periods and less loss of lubricant are said to result from the use of grease lubrication. Dead weight per car has been reduced by the lighter and more compactly designed journal box. As the grease used is satisfactory through temperature ranges varying from extreme summer heat to 40 deg. below zero Fahrenheit, it is a suitable all-year lubricant.

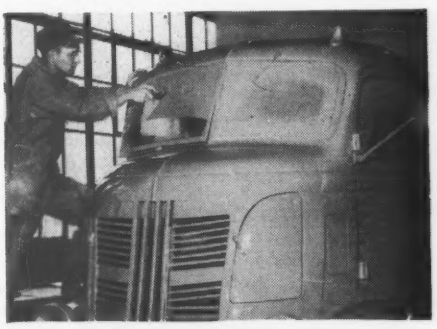


Exploded view of the Fafnir grease-lubricated journal box showing roller bearings for the radial load and the large ball bearing to take the thrust load

Liquid Masking Compound

A liquid masking compound for application to chrome trim, accessories, and glass with a brush or spray gun prior to painting has been announced by the Automotive and Aviation Service Division of Detrex Corporation, Box 501, Detroit 32, Mich. Called Detrex LPM, the compound dries to form a soft continuous white coating to protect the surface against paint overspray. After painting and any necessary buffing, polishing and water-sanding operations, LPM is removed without previous soaking by washing the vehicle with water, or, if preferred, it can be removed by scraping or peeling.

For masking out large areas or for coating walls adjacent to the location of the painting operation, the compound may be sprayed on with regular paint-spray equipment. A 20 per cent dilution —four parts of LPM and one part water —is recommended. For use on small areas where hand brushing is desirable, LPM can be applied as it comes, although a 10 per cent dilution with water is of better brushing consistency.



Removing Detrex LPM liquid masking compound with a hand scraper after completion of painting

Diesel Locomotive Ventilator

The Kerr locomotive ventilator is attached to a door opening of a Diesel locomotive during maintenance and inspection periods to furnish fresh air for those working inside the locomotive. The ventilator operates as a suction fan, exhausting hot air from one end of the locomotive while drawing fresh air through

The Kerr locomotive ventilator furnishes fresh air to workmen in Diesel locomotives during maintenance and inspection periods

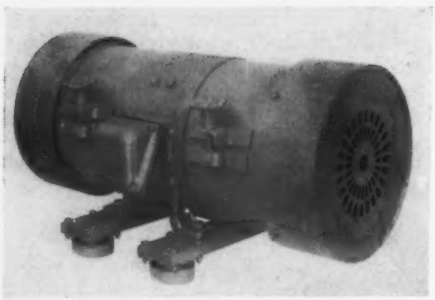
the other end and giving a complete change of air inside several times a minute. In cold weather the ventilator can serve as a shop heater or locomotive defroster.

Weighing approximately 160 lb. in the 1-hp. size, the ventilator can be lifted into place by two men. The weight of the unit is carried on an angle iron that rests on the locomotive door sill. Adapter plates and adjustments make the unit applicable to various size door openings. The unit is held in place by wedge-type locks that are pulled into place behind the hand rails adjoining the door opening. The transition piece from the door to the fan is made of 18-gauge black iron and is framed with 1-in. angle iron.

A propeller-type 36-in. fan is direct driven from a totally enclosed ball-bearing motor. All models use a 36-in. fan, with the number of blades varying from 2 to 6, capacities from 11,300 to 13,800 cu. ft. per min., and motor speeds from 870 to 1,750 r.p.m. The units are available in ½- or 1-hp. models and for use with single- or three-phase current from Whitney M. Kerr, 6109 Howe Drive, Mission, Kan.

2-Kw. Railroad Inverter

A variable voltage, variable frequency, simple railroad inverter is now being made by the General Electric Company. It is a three-phase inverter, designed to handle loads imposed by fluorescent lamps and electric razors. It also makes possible the use of low-cost uncompensated lamp ballasts, thus providing



Variable voltage, variable frequency inverter for railway passenger car service

considerable savings in cost of lamp installations and in space requirements.

With only one rotating unit, the simple inverter is compact and easy to maintain. Rated 2 kw. at 3,600 r.p.m., it operates on 34 volts d.c. and delivers 115-volt, a.c. power at 80 per cent power factor. It weighs approximately 200 lb. Its ball bearings are factory-greased for two years of normal operation.

The unit is of totally-enclosed, fan-cooled construction, with steel frames and protected cast iron end shields.

Agitating Cold Cleaning Machine

A cold cleaning machine has been introduced for washing metal parts by the Magnus Chemical Company, Inc., Garwood, N. J. The machine, trade-named the Krazy Dip, is fully automatic, requiring manual labor only to load and unload.

The machine cleans by mechanical agitation, moving the parts in the cleaning solution 160 times a minute and requiring no heating. It is designed to force the turbulent solution into all crevices and hard-to-reach areas, thereby removing and washing out carbonized oil and dirt.

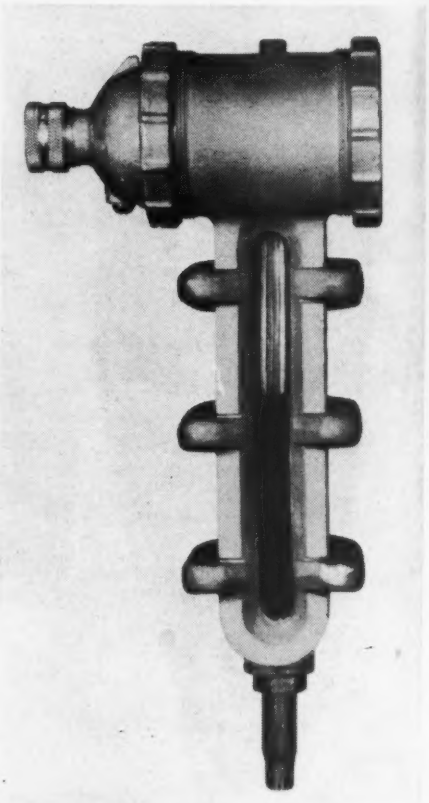
The Krazy Dip is built of 14-gauge

The Magnus Krazy Dip cold cleaning machine operates from a 50-lb. air line

hot-rolled steel sheet with a hinge cover complete with a fusible safety link. No pump, electric motor or speed reducer is required. It is operated by an air compressor with an air consumption from 1 to 2 cu. ft. per min. at a minimum air pressure of 50 lb. per sq. in.

Illuminated Reflex Water Gauge

A water gauge to intensify the visibility of the water level by spot-lighting the dividing line between the water and the steam has been developed by the Magnus Brass Manufacturing Company, Cincinnati 2, Ohio. Known as the Maglucent illuminated reflex water gauge, it has a light housing which can be at either the top or the bottom and which,



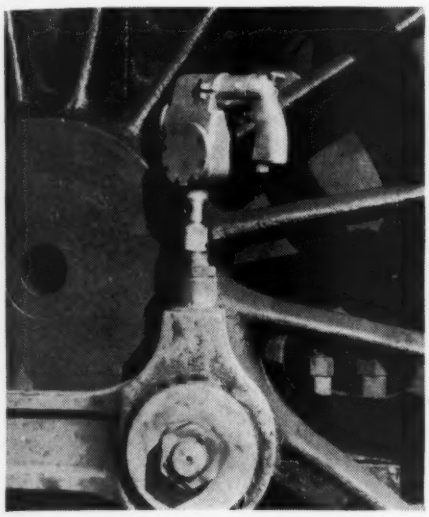
The Maglucent illuminated reflex water gauge spotlights the exact water line for both day and night visibility

in conjunction with a silvered-edge reflex glass, is designed to give a reflected light intensity greater than that obtained with a standard gauge. Standard railroad fixtures and bulbs are used throughout. It is thus possible to convert a regular gauge into this type of gauge by simply changing the front part of the gauge.

The body front and the lamp housing are a one-piece bronze casting. This forms a clamping plate to hold the reflex glass in place. The light enters the visible area of the gauge through an opening where the lamp housing and the gauge front meet. A spot on top of the glass is ground and polished to enable light to enter the glass at this point. The remainder of the glass is silvered on the edges, and the light which enters through the ground and polished portion is reflected from side to side and up and down on the inside of the glass. In the event of an electrical or a bulb failure the gauge can be illuminated by an external source of light through the non-silvered faces of the gauge glass.

Pneumatic Grease Gun

A lightweight, fast-operating pneumatic grease gun for locomotives, known as the "Spee-D" No. 369 Bluflash, has been developed by the Reliance Machine & Stamping Works, Inc., Jefferson-Tyler



Lubricating a rear crank-pin bearing with a pneumatic grease gun manufactured by the Reliance Machine & Stamping Works

bldg., Dallas 8, Tex. Weighing only 9½ lb., the gun is attached and operated with one hand. It is self-reversing, and its operation is continuous as long as the trigger is pressed, eliminating the need for reversing on each stroke.

The overall size of the grease gun is 8 in. by 10½ in., which size enables it to reach difficult locations. Grease can be injected at pressures up to 5,000 lb. per sq. in. A built-in. grease seal guards against grease leakage at any pressure.

Paint Stripper

A cold solvent material, Oakite Composition No. 15, designed to permit fast, thorough removal of paint and similar finishes from metal surfaces, has been announced by Oakite Products, Inc., 146 Thames street, New York 6. The composition, the manufacturer reports, is effective in removing baking japahs, wrinkle finishes, nitrocellulose lacquers, and synthetics, such as alkyds, phenolics, ureas, vinyls, etc., from such metals as steel, galvanized iron, die castings, aluminum, copper and brass, with no attack on the metal.

Designed for use at room temperature, Oakite Composition No. 15 may be applied by the tank immersion method or by swabbing or brushing. This is followed by a hot pressure-rinse to remove loosened paint particles.

Fuel Additives

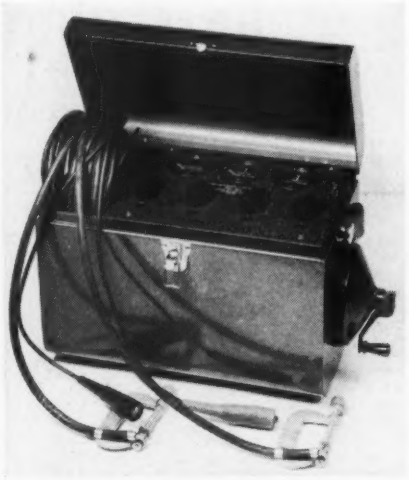
A chemical additive said to improve cylinder lubrication in Diesel or gasoline engines when added to the gasoline or Diesel fuel is manufactured by Lubri-Gas International, Inc., 221 North LaSalle street, Chicago 1. The base stock of the additive is S.A.E. 40 lubricating oil to which has been added about 10 per cent of Lubri-Gas chemicals. The chemicals added to the lubricating oil contain no acids or other materials injurious to metal parts.

When the Lubri-Gas mixture has been added to gasoline or Diesel fuel the oil is said to become a part of the fuel. As the mixture burns in the cylinders, the Lubri-Gas portion, reportedly impervious to the heat developed by the explosion, condenses to its original state and thereby lubricates the moving part in the combustion chamber. As a result friction, drag, carbon deposits and overheating are reduced, also fuel consumption and maintenance cost.

Transformer Turn Ratio Test Set

The James G. Biddle Co., 1316 Arch street, Philadelphia 7, Pa., has developed and is now offering a portable, direct-reading instrument for measuring turn ratio in power transformers. The set is designed for use on all types and sizes of power, distribution and auto transformers in common use, and reduces to a simple operation what heretofore has been a somewhat difficult task of measuring transformer ratio. Such measurements have frequently been a missing element during final inspection and at installation of transformers, and also are particularly helpful in analyzing transformer troubles and identifying tap connections. The set also gives an immediate indication of polarity.

The transformer turn ratio test set consists of a multi-ratio reference transformer which is excited by means of a small hand generator, in parallel with the transformer under test. By means of four dial switches and a null balance indicator, the reference transformer is adjusted in ratio to equal that of the transformer under test. The ratio is then read directly from the dial switch indexes. Ratios up to 130 can be measured with an accuracy to within one part in 1,000. The set operates without burden, at low-voltage excitation and by null balance, and therefore gives a precise measurement of no-load voltage ratio. It is supplied complete with testing leads and weighs about 31 lb. It is intended for both shop and field use.



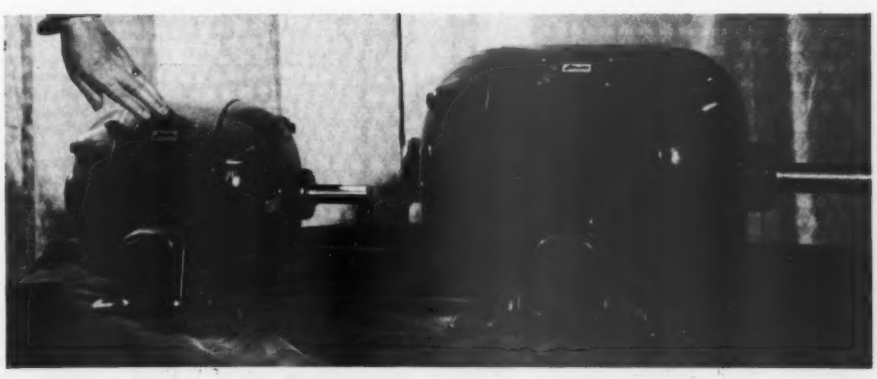
The test set with leads is contained in a single carrying case

High-Temperature Induction Motors

Silicone resins for winding insulation and silicone grease for bearing lubrication has made it possible for the Westinghouse Electric Corporation to reduce the size of the Life-Line a.c. motors so that a totally-enclosed non-ventilated motor in a 5-hp. 4-pole rating is now being made in the same frame sizes as the open motor of the same rating. This permits reductions of as much as three frame sizes from present standard Class A insulated totally-enclosed motors. The efficiency, power factor and torque of such a motor are comparable to those for an open motor of the same rating.

The illustration shows the size reduction possible through the use of silicones. The motor on the left is a Westinghouse 5-hp., 1,750-r.p.m., 4-pole, silicone insulated all-steel Life-Line motor in the 254-frame. The one on the right is rated the same, but is Class A insulated and is in a 326-frame. The weight by using silicone is reduced from 250 lb. to 145 lb., or is 60 per cent of the Class A insulated motor. Height is reduced 3¼ in. and length, 7¼ in.

This reduction in size and weight is possible by designing to take full advantage of the higher permissible temperature of silicone insulation. Such designs make possible the opening of new fields in motor applications where space is at a premium.

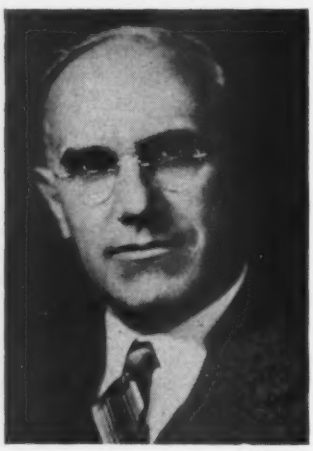


Insulation accounts for the difference in size of these two 5-hp., 1,750-r.p.m., 4-pole motors

NEWS

Sieger Appointed AWS President

GEORGE N. SIEGER, president of the S-M-S Corporation, Detroit, Mich., has been elected president of the American Welding Society for the year 1948-49. Mr. Sieger, who was first vice-president



G. N. Sieger

of the society during 1947-48, is a graduate of Lehigh University where he received the degree of electro metallurgist. He is also a past president of the Resistance Welder Manufacturers Assn.

Coordinated Associations Adopt Constitution

BY official action of the six individual railroad mechanical associations which met in annual convention at Chicago in September, a joint constitution, or plan of organization, was adopted to cover the activities of the group as a whole. The name chosen was "Coordinated Railroad Mechanical Associations." The officers include a chairman, vice-chairman and secretary, elected by a coordinated executive committee comprising the president, first or senior vice-president and secretary of each member association.

The chairman and vice-chairman, who must be members of the A.A.R. Mechanical Division and actively engaged in railway service, will hold office for two years from date of election. The present officers are J. E. Goodwin, executive assistant to the president, Chicago & North Western, chairman; J. M. Nicholson, assistant to vice-president, Atchison, Topeka & Santa Fe, vice-chairman, and C. F. Weil, American Brake Shoe Company, secretary. The six associations represented include the Air Brake Association; Car Department Officers' Association; Electrical Section, A.A.R. Mechanical Division; Locomotive Maintenance Officers' Association; Master Boilermakers' Association, and Railway Fuel & Traveling Engineers' Association.

There will be a full display of exhibits at each alternate convention, conditions permitting, starting in the year 1949 under the auspices of the Allied Railway Supply Association, and exhibits under the auspices of the Railway Electric Supply Manufacturers' Association at each alternate convention starting in the year 1950. A member of any coordinated association, wearing his badge, will be entitled to free admission to all of the exhibits. Each association is urged to devote one afternoon to viewing the exhibits, if possible. Room entertainment during the time any of the associations is in session will not be permitted. Any member wearing a badge of the coordinated associations will be permitted to attend the member meetings of any of the other associations while in session.

Gas Turbine-Electric Locomotive Begins Track Tests

THE first gas turbine-electric locomotive to be built and operated in the United States, an Alco-GE 4,500-hp. unit, began track tests on November 15, at the General Electric plant in Erie, Pa.

The locomotive will be placed in operation on a demonstration basis by the Union Pacific next spring, after preliminary tests have been completed in the east.

Spokesmen for the American Locomotive and General Electric companies pointed out that lengthy factory and road tests must be conducted before any real indications of the ultimate success of gas turbine powered locomotives can be obtained.

Orders and Inquiries for New Equipment Placed Since the Closing of the November Issue

LOCOMOTIVE ORDERS

Road	*No. of locos.*	*Type of loco.*	*Builder*
Canadian Pacific	12[1]	1,500-hp. Diesel-elec. road frt.	American Loco.
	5[1]	1,500-hp. Diesel-elec. road switch	American Loco.
	3	1,000-hp. Diesel-elec. yard switch	American Loco.
	3	2,000-hp. Diesel-elec. pass.	Electro-Motive
Erie	4[2]	660-hp. Diesel-elec. switch	American Loco.
	4[2]	1,000-hp. Diesel-elec. switch	American Loco.
	4[2]	750-hp. Diesel-elec. switch	Baldwin Loco.
	2[2]	1,000-hp. Diesel-elec. switch	Baldwin Loco.
	6[2]	1,000-hp. Diesel-elec. switch	Electro-Motive
	6[2]	1,000-hp. Diesel-elec. switch	Lima-Hamilton
Nashville, Chattanooga & St. Louis	9[3]	1,500-hp. Diesel-elec. road units	Electro-Motive

FREIGHT-CAR ORDERS

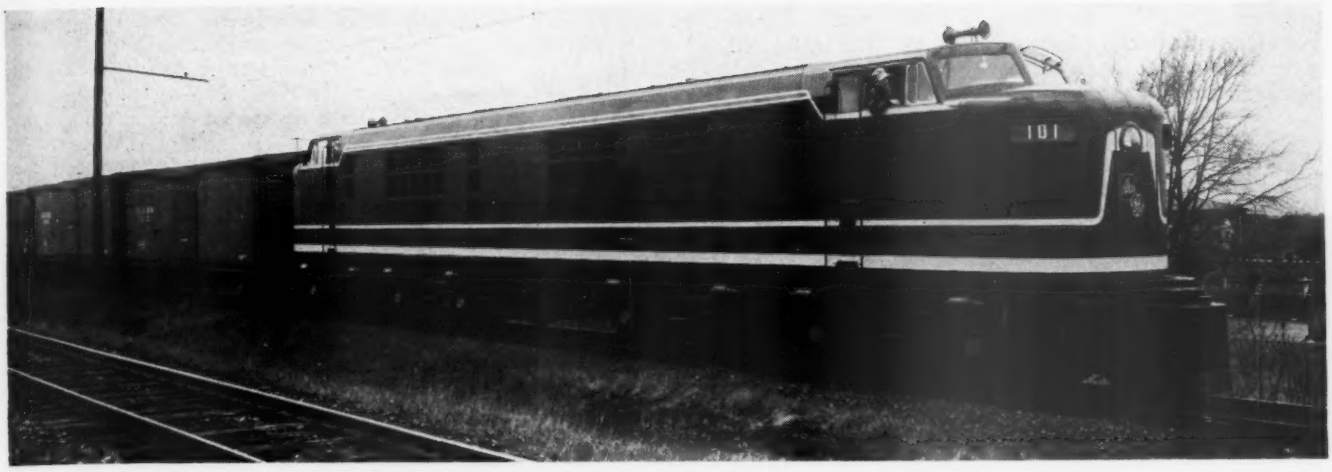
Road	*No. of cars*	*Type of car*	*Builder*
Atchison, Topeka & Santa Fe	50	Gondola	Co. shops
	250	70-ton covered hopper	Co. shops
Canadian Pacific	500	50-ton box	National Steel Car
Chicago & North Western	242[4]	50-ton box	Pullman-Standard
Chicago, Milwaukee, St. Paul & Pacific	2,330	Gondola	Co. shops
	1,000	Box	Co. shops
	500	Flat	Co. shops
	50	Caboose	Co. shops
Chicago, Rock Island & Pacific	1,000	70-ton gondola	Co. shops
Green Bay & Western	20[5]	50-ton hopper	Pullman-Standard
Merchants Despatch Transportation Corp.	60	55-ton refrigerator	Despatch Shops
Mississippi Central	100[6]	50-ton box	Pullman-Standard
Missouri-Kansas-Texas	25	Caboose	Co. shops
	500[7]	70-ton hopper	Pressed Steel
Southern	50[8]	50-ton box	Pullman-Standard
Wisconsin Central	20[9]	70-ton covered hopper	General American

FREIGHT-CAR INQUIRIES

Denver & Rio Grande Western	50	70-ton mill-type gondola
	200	70-ton flat-bottom gondola
	500	50-ton drop-bottom gondola
Western Pacific	250	70-ton gondola

[1] Of the 12 road freight units, 8 are "A" type and 4 of the "B" type.
[2] Delivery expected to begin in the first quarter of 1949 and completed in the second quarter of 1950.
[3] To cost $1,551,092. These locomotives, together with 21 similar units previously ordered from Electro-Motive, will make possible the complete Dieselization of all trains—both freight and passenger—between Nashville, Tenn., and Atlanta, Ga., with the exception of local freights. Symbol freight trains between Nashville and Bruceton, Tenn., will be Dieselized, as well as pusher service over Cumberland mountain at Cowan, Tenn.
[4] Two hundred, for the Chicago, St. Paul, Minneapolis & Omaha, are scheduled for December delivery. The other 42, for the C. & N. W., were scheduled for delivery in November.
[5] Delivery of the cars, 10 of which are for the Kewanee, Green Bay & Western, is expected in April.
[6] For delivery in April.
[7] To cost over $2,250,000. Delivery expected in April and May.
[8] Delivered in November.
[9] Order subject to court approval. If approved, delivery will be scheduled for second quarter of 1949.

NOTES: *Baltimore & Ohio.*—Baltimore & Ohio is rebuilding 677 gondola cars at its DuBois, Pa., Glenwood, Willard, Ohio, and Chillicothe shops, which are turning out a total of 23 cars each work day. *Great Northern.*—Directors of the Great Northern have authorized the purchase of 30 sleeping cars, 6 coaches, 6 dining cars, 6 coffee shop cars, 6 observation cars, 6 baggage cars and 6 baggage-mail cars at an estimated cost of $8,500,000. Delivery of the new equipment is expected in 1951. The G. N. plans to replace cars on the present "Empire Builder" entirely with new equipment when it is delivered. Equipment now on the "Empire Builder" will be used to streamline the "Oriental Limited."



The gas turbine-electric locomotive on the General Electric test track at Erie, Pa.

The new locomotive utilizes the same power plant that was exhibited in Schenectady last March at the Alco-GE Railroad Executives' Conference.

Although the gas turbine currently is fired by Bunker C oil, Alco-CE spokesmen are hopeful that special research efforts, coupled with experience gained from the operation of this first locomotive design, may lead to the development of successful means of burning coal in a gas turbine locomotive. They disclosed that Alco-GE is cooperating with the Locomotive Development Committee of Bituminous Coal Research towards that end.

The locomotive is of single-cab construction with an operating station in each end and has B-B-B-B running gear. It develops 53 hp. per foot of length, with a continuous tractive force of 68,400 lb. at 20.4 m.p.h. It is 83 ft. 7½ in. long inside of knuckles, 15 ft. 4 5/16 in. high over cab, and 10 ft. 7 in. wide over hand rails. The total weight is 500,000 lb. Geared for 79 m.p.h., the locomotive carries enough fuel for 12 hours operation at 4,500-hp.

The compressor, combustion chamber and turbine are of in-line construction. Air is drawn through a compressor into several combustion chambers. Fuel is injected and the mixture burns, raising the temperature of the compressed air. The resulting gases expand and move at high velocity against the turbine blades, turning the shaft. The shaft drives both the power plant compressor and the generator. Power from the generator is supplied to eight traction motors, each of which drives one of the eight axles.

Supply Trade Notes

ALLIS-CHALMERS MANUFACTURING COMPANY.—*B. F. Bilsland,* manager of the Chicago district of the Allis-Chalmers Manufacturing Company, has been appointed manager of the newly formed Midwest region, with headquarters at Chicago, *J. C. Collier* succeeds Mr. Bilsland as Chicago district manager.

◆

GREAT LAKES STEEL CORPORATION.—*Frank F. Ford* and *Clemson N. Page* have been appointed sales representatives for the *Great Lakes Steel Corporation's* nailable steel flooring. Mr. Ford, who will be located in Atlanta, Ga., has been connected with the alloy and Stransteel divisions of the company. Mr. Page will have offices in Philadelphia, Pa.

◆

PAXTON-MITCHELL COMPANY.—*E. M. Hendrickson,* chief engineer of the Paxton-Mitchell Company and its subsidiary, *Paxton-Diesel Engineering Company,* for the past three years, has been appointed sales manager, succeeding *George T. Badger,* resigned.

Mr. Hendrickson is a graduate of Kansas State College. He worked in the engineering department of the Union Pacific for four years and in the engineering department of the Chicago & North Western for a year and a half, leaving the latter company to join the engineering staff of the T. Z. Railway Equipment Company. Mr. Hendrickson joined Paxton-Mitchell in 1935 as a

E. M. Hendrickson

sales engineer, and served the Chicago territory until Sept., 1945, when he became chief engineer at Omaha, Neb.

◆

BLACK & DECKER MFG. CO.—*R. A. Wernsdorfer,* service engineer in charge of repair and service of electric tools at the Atlanta, Ga., branch of the Black & Decker Mfg. Co., has been transferred as a service engineer to the Baltimore, Md., branch. *G. C. Wilhide, Jr.,* succeeds Mr. Wernsdorfer at Atlanta.

◆

LINK-BELT COMPANY.—*Crozier S. Wileman,* district sales engineer of the Link-Belt Company at Philadelphia, Pa., has been appointed district sales engineer at Wilkes-Barre, Pa., succeeding *A. C. Williams,* who has retired.

◆

HANCHETT MAGNA-LOCK CORPORATION.—The Hanchett Magna-Lock Corporation of Big Rapids, Mich., has been organized to continue the line of magnetic chucks formerly produced by the Hanchett Manufacturing Company, also of Big Rapids. J. F. Manting is president of the new company; D. D. Stone, vice-president and treasurer, and R. V. Hanchett, secretary. The Hanchett Magna-Lock Corporation is entirely separate and apart from the Hanchett Manufacturing Company, but the new company will use the name "Hanchett" for a short time.

◆

CARNEGIE-ILLINOIS STEEL CORPORATION.— *J. Norman Quinlan,* division superintendent of the west mills of the Carnegie-Illinois Steel Corporation at Gary, Ind., has been appointed assistant to general superintendent of the plant; *Charles J. Hunter,* chief metallurgist and chief inspector, succeeds Mr. Quinlan as division superintendent of the west mills; *Oscar Pearson,* formerly assistant superintendent of steel production and assistant to division superintendent of steel production and central mills, succeeds Mr. Hunter as chief metallurgist and chief inspector, and *Ragnar Overberg*

succeeds Mr. Pearson as assistant superintendent of steel production and assistant to division superintendent of steel production and central mills.

◆

BUDD COMPANY.—The Budd Company has organized a department to manufacture the firm's railroad disk brake at its Red Lion plant, Philadelphia, Pa. The new department, an expansion of the organization which has manufactured the disk brakes since they first were made available to the railroads in 1938, is scheduled to begin quantity production about January 1.

◆

ARO EQUIPMENT CORPORATION.—*Ralph W. Morrison* has been appointed general sales manager of the Aro Equipment Corporation. *E. W. Iman*, sales manager of the lubricating equipment division; *E. L. Jackson*, sales manager of the industrial tool division; and *M. J. Anderson*, manager of the fittings division.

Mr. Morrison joined the Aro organization in 1940 as Detroit division manager. In 1941 he was appointed assistant sales manager of the Air Tool division and later became sales manager of the division.

Ralph W. Morrison

◆

VAPOR HEATING CORPORATION.—*Franklin E. Hess*, manager of the Philadelphia, Pa., office of the Vapor Heating Corporation, has been appointed eastern division manager, retaining his office in Philadelphia, but with jurisdiction over New York territory. *Anthony F. Retta* has been appointed manager of the New York district. *M. K. Loomis* has been transferred from the sales department at the New York office to the Philadelphia office. *H. J. Schickedanz* has been promoted from the service department in Chicago to the sales department in New York. *R. C. Smykal* has been transferred from the service department in Chicago to the service department in New York, and *G. R. Wallace*, formerly in the service department in New York, has been appointed acting assistant service manager at Chicago.

Mr Hess entered the service department of the Vapor Corporation in October, 1932. He was later transferred to the sales department; was appointed manager of the St. Paul, Minn., office on December 1, 1940, and was transferred to Philadelphia on January 1, 1946.

Mr. Retta became an employee in the service department of the company at New York in August, 1922. He was later transferred to the sales department and for several years has been assistant manager of the New York office.

Mr. Loomis became steam generating engineer of the company in the Chicago territory in 1936. In 1937 he was transferred to the service department at New York where he was later transferred to the sales department.

Mr. Schickedanz entered the service department in February, 1947, at Chicago where he became assistant service manager in July, 1947.

Mr. Smykal entered the employ of the Vapor Corporation in March, 1947. He was subsequently transferred to the service department at Chicago and still later was temporarily assigned to the service department at Washington, D. C.

Mr. Wallace was transferred from the manufacturing plant to the service department at Chicago in January, 1947. Later in that year he was moved to the service department at New York.

◆

ALL-STATE WELDING ALLOYS COMPANY.—*Herman C. Phelps*, formerly west coast regional sales manager of the All-State Welding Alloys Company, has been appointed sales manager with headquarters in White Plains, N.Y.

NATIONAL ALUMINATE CORPORATION.—The title of *C. A. Brown*, railroad service, of the National Aluminate Corporation has been changed to mechanical engineer, railroad department.

◆

AMERICAN CAR & FOUNDRY CO.—*R. M. Hoel* and *T. C. Ballou* have been appointed sales agents representing the American Car & Foundry Co. in the north eastern railroad area, with headquarters at New York. *G. L. Holt* has been appointed assistant district manager of the Madison, Ill., plant of A.C.F.

R. M. Hoel

Mr. Hoel, who has been a member of the sales department since 1946 comes from the Pittsburgh, Pa., office.

Mr. Ballou joined American Car & Foundry in 1936 and since that time has specialized in welded products and tank cars. From 1942 to 1946 he served as a lieutenant in the United States Navy.

T. C. Ballou

◆

J. H. DEPPELER, chief engineer of the Metal & Thermit Corp., has been granted a leave of absence for the purpose of establishing his own office as a consulting engineer, at 36 West 40th Street, New York.

◆

TWIN DISC CLUTCH COMPANY.—*John H. Batten*, formerly executive vice-president of the *Twin Disc Clutch Company*, has been elected president. *P. H. Batten*, founder of the company, who previously held the positions of president and chairman of the board, will maintain active interest in company affairs as chairman of the board of directors.

◆

EUTECTIC WELDING ALLOYS CORPORATION.—*Jack R. Koske*, formerly welding engineer has been appointed regional sales supervisor of the Eutectic Welding Alloys Corporation in the east central section of the United States.

◆

ELECTRIC STORAGE BATTERY COMPANY.—*Roland Whitehurst*, Exide sales manager, has been elected vice-president in charge of sales of the *Electric Storage Battery Company* to succeed *Frank T. Kalas*, who has retired after 49 years of service with the firm.

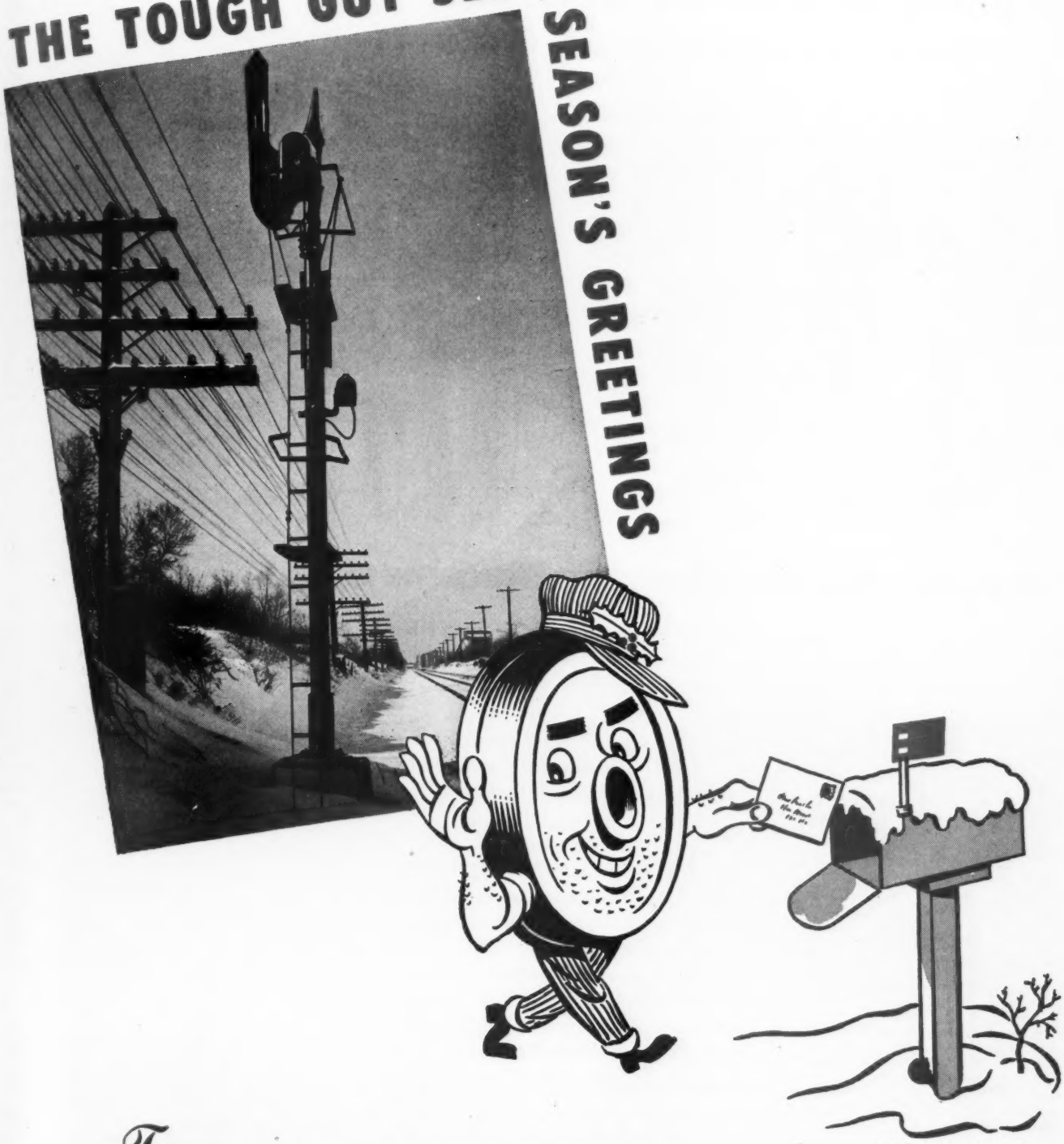
◆

GENERAL ELECTRIC COMPANY.—*C. I. MacGuffie* and *R. C. Freeman* have been appointed, respectively, manager of sales and manager of engineering of the *General Electric Company's* electric welding divisions.

◆

BUDA COMPANY.—The Buda Company, Harvey, Ill., has acquired *W. F. Hebard & Co.*, 336 West 37th street, Chicago, manufacturers of materials-

THE TOUGH GUY SENDS SEASON'S GREETINGS



The Tough Guy who typifies the Chilled Car Wheel and we at the AMCCW hope that the Clear Aspect will symbolize a clear and untroubled future for railroad men in 1949.

Merry Christmas and Happy New Year to all!

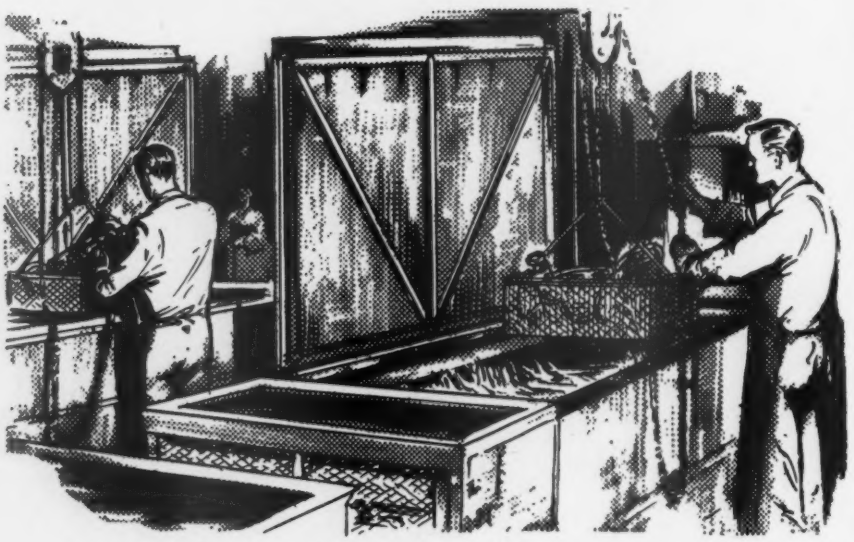
7018

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

445 NORTH SACRAMENTO BOULEVARD, CHICAGO 12 ILL.

American Car & Foundry Co. • Canadian Car & Foundry Co. • Griffin Wheel Co.
Marshall Car Wheel & Foundry Co. • New York Car Wheel Co. • Pullman-Standard Car Mfg. Co.
Southern Wheel (American Brake Shoe Co.)

Put *Flexibility* into Your Cleaning Along with Better Work and Much Lower Over-All Costs . . .



Magnus Aja-Dip Cleaning Machines

have shown that they do a better cleaning job in less time, with less labor and on a more flexible basis than any other methods now in use in railroad shops.

They are used, along with the Magnus Cleaners best adapted to the individual cleaning operation, on all kinds of units and parts, including:

Air Filters	*Signal Elements*
Compressors	*Electrical Equipment*
Diesel Blocks and Parts	*Steam Locomotive Parts*

The savings reported by railroad users run along these lines: "Parts are ready for reinstallation in ¼ of the time formerly required." "70% saved in time with a 10% increase in output." "Clean in 45 minutes loads that formerly took 8 hours." "One eight-hour shift turns out miscellaneous cleaned parts that used to take 36 hours."

Nine of the big roads are already depending on Magnus Aja-Dip Machines and Magnus Chemicals for many of their cleaning operations. It certainly will pay you to write for Bulletin #407 and see what Magnus can do for you.

Magnus on Other Cleaning Jobs

There are specialized Magnus Cleaners for many other railroad operations where cleaning machines are not involved, such as:

- Coach Washing, Interior and Exterior
- Floor Cleaning—All Types
- Freight and Refrigerator Car Cleaning
- Upholstery Cleaning

They are also worth looking into!

MAGNUS CHEMICAL COMPANY • 77 South Ave., Garwood, N. J.
In Canada—Magnus Chemicals, Ltd., 4040 Rue Masson, Montreal 36, Que.

RAILROAD DIVISION
Magnus
CLEANERS • EQUIPMENT • METHODS
Service representatives in principal cities

handling equipment, including "Shop Mule" tractors and lift trucks. The newly acquired company will be operated as a wholly owned subsidiary of Buda and will continue to manufacture its present line of products.

◆

NATIONAL LEAD COMPANY.—The *Magnus Brass Manufacturing Company* has discontinued operation of its Baltimore, Md., plant, and the line of "Coale" safety and blower valves will be manufactured in the Cincinnati, Ohio, plant of the Magnus brass division of the National Lead Company.

◆

WATSON-STILLMAN COMPANY.—*J. T. Gillespie, Jr.,* has been appointed to the newly created position of sales manager of the Watson-Stillman Company, Roselle, N. J. H. E. Elliott continues as assistant sales manager over the railroad, metal-working, and general industrial equipment division; James Wilson as assistant sales manager in charge of the plastics molding machinery division, and John P. Bittenbinder as assistant sales manager directing distributor products sales. All three are under the direction of Mr. Gillespie, who is directly responsible to A. G. York, vice-president in charge of sales.

◆

UNITED STATES RUBBER COMPANY.—*Howard W. Weber* has been appointed chief engineer and *A. S. Basil* general sales manager of the wire and cable department of the United States Rubber Company. Mr. Basil has been associated with the company since 1926 and Mr. Weber since 1934. Other appointments include *H. J. MacDonald,* assistant to the manager; *H. F. Johnson,* assistant general sales manager; *R. A. Walker,* merchandise manager; *J. A. Leuver,* assistant sales manager in charge of distribution; *D. B. Karlskind,* assistant sales manager in charge of commodities, sales engineering and new projects; *G. E. Hubrig,* sales manager, western division, and *C. A. Bartron,* chief sales engineer.

◆

LEHON COMPANY.—*Harry A. Wolfe,* who recently resigned as Chicago district manager of the Buda Company, has rejoined the sales organization of the Lehon Company, as division sales manager, railway department, with headquarters at Chicago. *Clarence E. Croisant,* sales supervisor, railway department, and *A. C. Senseney,* sales engineer, railway department, have both been appointed division sales managers, railway department, with headquarters at Chicago.

Mr. Wolfe was born in 1897 and attended Valparaiso University. In 1916 he became a clerk in the accounting department of the Chicago, Milwaukee, St. Paul & Pacific. In 1918 he entered the armed forces of the United States, serving with the 96th division. In 1919 he returned to the Milwaukee as chief clerk to the superintendent of motive power, and in 1922 was promoted to the position

PROBABLY no railroad man need be told that every carload of C & O's record-breaking tonnage moved behind steam.

Nor will it surprise many that almost every ton made most of its miles behind Lima-built locomotives.

The significant point is this: Here is an example of what *modern* steam power can do. It is a special example, to be sure, but a concrete one. Those are real locomotives, making real miles, moving real tonnage—and lots of it. Almost to an engine, they are modern—modern from the rims up, from the pilots back.

Could any other type of power—including older steam locomotives—have equalled C & O's cost per ton-mile?

We doubt it. That's why we say there *is* a place for steam—and in this place, the modern steam locomotive can do, and is doing, an outstanding job.

It's worth thinking about.

C. & O. Sets All-Time Record, Ships 90 Million Tons of Coal

ST. ROBERT J. BOWMAN

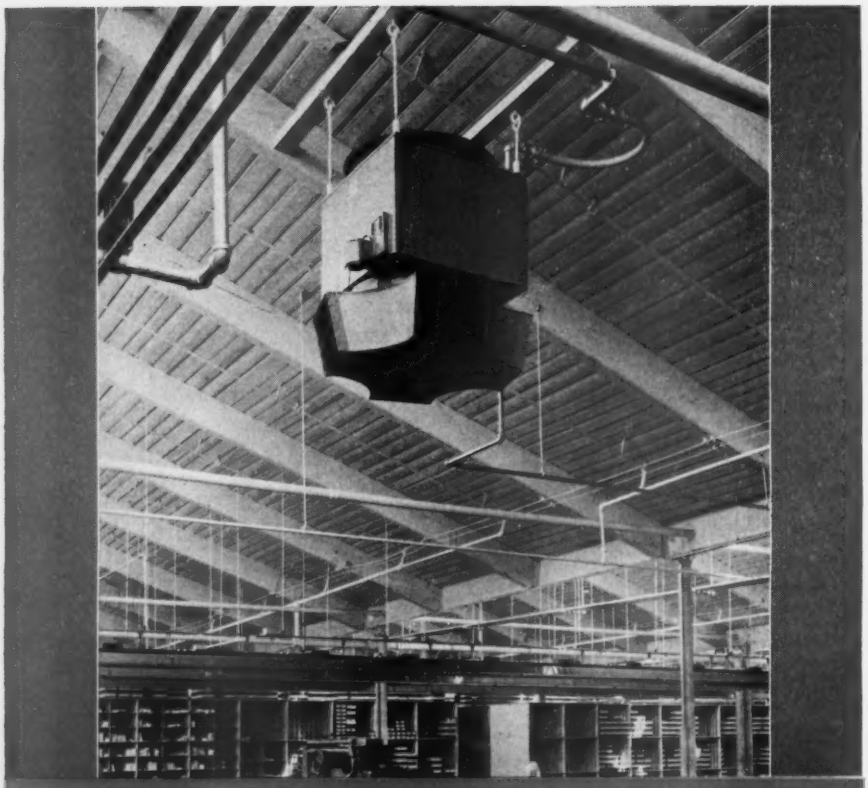
record will be bettered with the completion, in the coming year, of two branch lines which will open up new coal areas. Also new mines, along with widespread mechanization of existing mines, should increase

this is steam at work

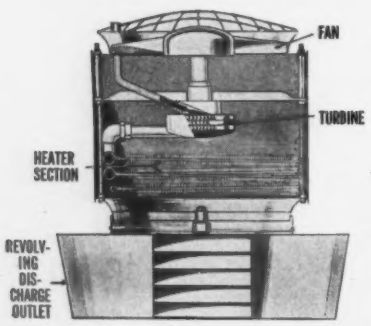
LIMA HAMILTON CORPORATION

DIVISIONS: *Lima, Ohio*—Lima Locomotive Works Division; Lima Shovel and Crane Division. *Hamilton, Ohio*—Hooven, Owens, Rentschler Co.; Niles Tool Works Co.

PRINCIPAL PRODUCTS: Locomotives; Cranes and shovels; Niles heavy machine tools; Hamilton diesel and steam engines; Hamilton heavy metal stamping presses; Hamilton-Kruse automatic can-making machinery; Special heavy machinery; Heavy iron castings; Weldments.



Wing Turbine Driven Heater uses exhaust from fan turbine for heating



Where live steam of any pressure is available, it is possible to heat railroad shops or offices advantageously by installing Wing Turbine Revolving Unit Heaters. The fan is driven by a Wing Turbine and the turbine exhaust is piped into the heater section. Electric motor and electric power are eliminated as the source of power (steam) is also the source of heat. The revolving discharge outlet distributes the heat to the working level, flowing around obstructions into repair pits and farthermost corners. Workers are pleased with the sensation of fresh, live, invigorating warmth. Write for descriptive bulletin or specific details.

L. J. Wing Mfg. Co. 52 Seventh Ave., New York 11, N.Y.

Factories: Newark, N. J. and Montreal, Canada

Wing

Revolving UNIT HEATERS

of supervisor of fuel. In 1926 he became a special representative for the Lehon organization and 14 years later was appointed supervisor of railroad sales. In 1944 Mr. Wolfe left The Lehon Company to become field representative of The Buda Company, subsequently being appointed district manager, with headquarters at Chicago.

◆

BALDWIN LOCOMOTIVE WORKS. *E. R. Wisner* has been appointed assistant to the vice-president in charge of sales, Eddystone division of the Baldwin Locomotive Works, and *Walker H. Evans* succeeds Mr. Wisner as district manager of the Philadelphia, Pa., district. Mr. Evans joined Baldwin in 1916 and

Walker H. Evans

worked in the shops and as erecting engineer in France until 1920, when he was assigned to the Chicago office. In 1932 he was appointed Philadelphia district manager for the Standard Steel Works division and later worked as transportation salesman in the Philadelphia office.

◆

GIDDINGS & LEWIS MACHINE TOOL CO.—The Giddings & Lewis Machine Tool Co. has purchased the Cincinnati Planer Company, which will be operated as a wholly owned subsidiary.

◆

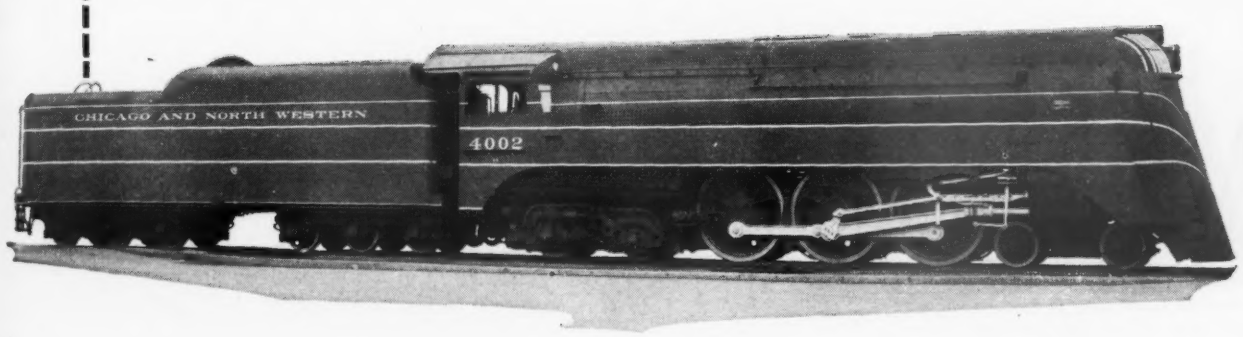
DAMPNEY COMPANY OF AMERICA.—*The R. J. Denton Company,* Syracuse, N. Y., has been appointed distributor in the Syracuse area for the Apexior and Thurma-Lux protective coatings of the Dampney Company of America.

◆

UNION ASBESTOS & RUBBER CO.—*Frank L. Myers* has been appointed to head the newly established glass fiber department of the Union Asbestos & Rubber Co. Mr. Myers, who was formerly asociated with the Owens-Corning Fiberglass Corporation, will have his headquarters at 1811 South Fifty-fourth avenue, Cicero 50, Ill.

◆

HAMILTON-THOMAS CORPORATION.—The Hamilton-Thomas Corporation, Hamilton, Ohio, has been organized to operate Economy Pumps, Inc., the Kipfel Manufacturing Company and Liberty Planners, Inc. *Richard Thomas* is presi-



Security "Dutch Ovens"

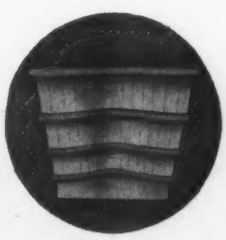
in C. & N. W. Oil-Burning Locomotives

Recently a new type pre-combustion chamber or Security "Dutch Oven" has been adopted as standard equipment for C. & N. W. oil-burning locomotives operating between Chicago and Omaha.

The Security "Dutch Oven" is located at the oil-burning nozzle end of the firepan. The radiation from the hot refractory surface of the oven chamber flashes the atomized oil as it travels along the center of the firepan. This increases efficiency of combustion, reduces carbon formation, and results in a better steaming boiler.

For nearly forty years the Chicago & North Western has been using the Security brick arch as standard equipment in coal-burning locomotives.

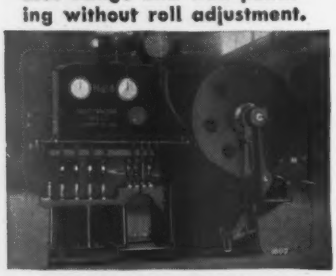
HARBISON-WALKER REFRACTORIES CO.
Refractories Specialists



AMERICAN ARCH CO. INC.
60 East 42nd Street, New York 17, N. Y.
Locomotive Combustion Specialists

BEATTY Hydraulic Vertical Bulldozer for heavy forming and pressing.

BEATTY Spacing Table handles flange and web punching without roll adjustment.



BEATTY No. 14 Toggle Beam Punch for structural steel fabrication.

BEATTY 250-Ton Gap Type Press for forming, bending, flanging, pressing.

BEATTY Horizontal Hydraulic Bulldozer for heavy forming, flanging, bending.

Obsolete Machines mean OBSOLETE COSTS!

Machines with that "Gay Nineties" look have no place in today's production. Today's high costs of labor, materials, overhead, call for EFFICIENCY —the most modern machine tools that can be developed. And that's our job —to design and build machines to do the job *better, faster* at *lower cost.* If the pressure is on you to build your product for *less,* let us review your machine tools and make recommendations. There's a *better* way to handle most production jobs, and our job is to help you find that *better* way.

HYDRAULIC HEAVY METAL WORKING EQUIPMENT

BEATTY MACHINE AND MFG. COMPANY
HAMMOND, INDIANA

dent of the new company; *L. G. Thomas,* executive vice-president, and *H. R. Ryan* and *R. H. Thomas, Jr.,* vice-presidents.

◆

FRANKLIN RAILWAY SUPPLY COMPANY.—*Lloyd B. Jones,* formerly engineer of tests for the Pennsylvania, has been retained as consulting engineer by the Franklin Railway Supply Company.

◆

INDEPENDENT PNEUMATIC TOOL COMPANY.—*William J. McGraw,* manager of electric tool sales in the New York territory for the Independent Pneumatic Tool Company, has been appointed manager of the company's Cleveland, Ohio, branch. *E. B. Rosell,* electric tool service engineer in the Chicago branch territory, succeeds Mr. McGraw in the New York territory.

Obituary

THOMAS D. HOGAN, president of the Orme Company, died recently at his home in Michigan City, Ind.

◆

HUGH E. CREER, who retired several years ago as vice-president of the Camel Sales Company, with headquarters at Chicago, died at his home in Mountain Grove, Mo., on October 12.

◆

WILLIAM M. OLSEN, western district sales manager, Chicago division, of the Lamson & Sessions Company, died on October 5.

Personal Mention

General

CHARLES DUVAL AIKEN, engineer of motive power of the Richmond, Fredericksburg & Potomac at Richmond, Va.,

C. DuVal Aiken

has been appointed mechanical engineer with headquarters at Richmond. Mr. Aiken, who was born on September 15, 1907, at Richmond, is a graduate of Vir-

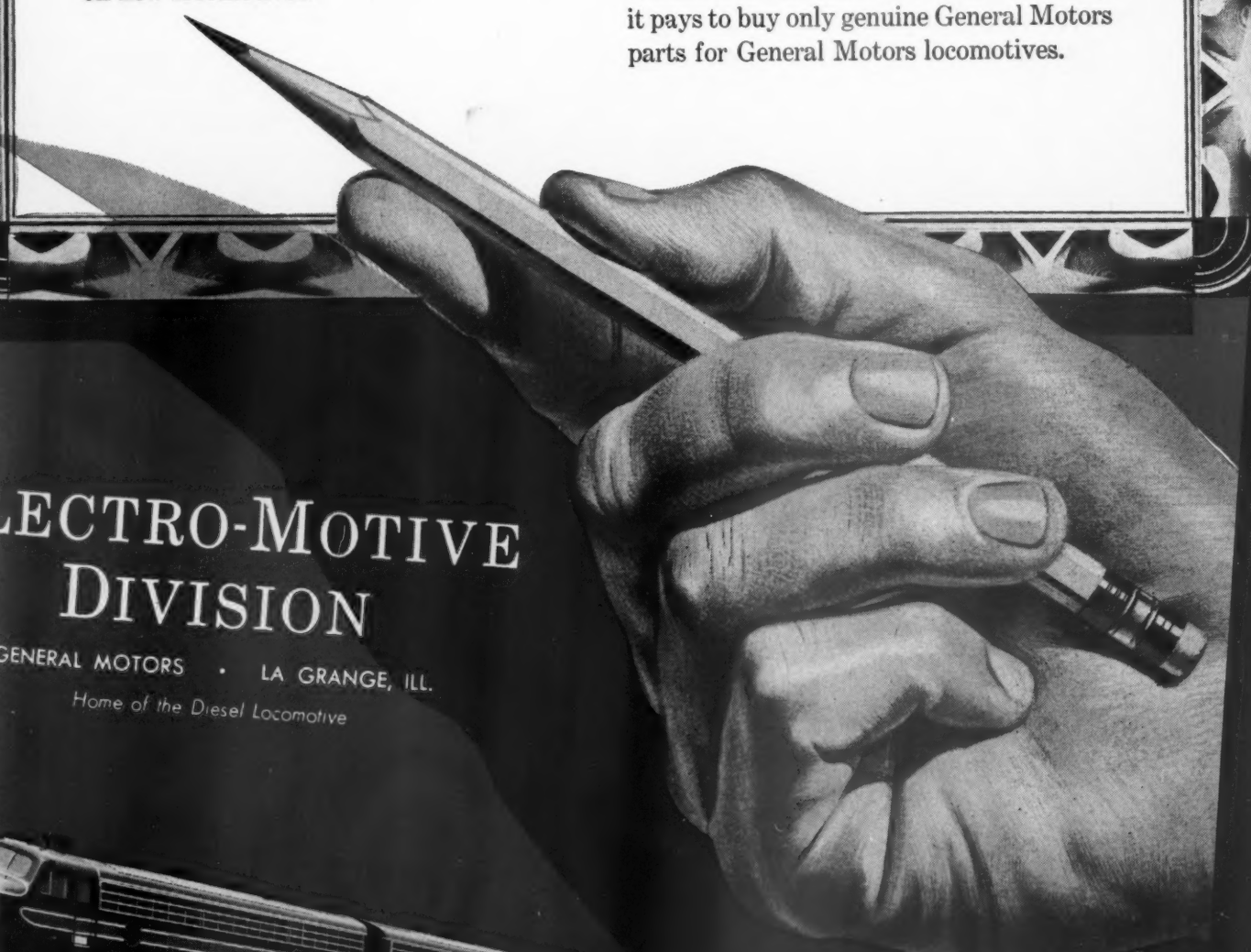
You get a WARRANTY with every new General Motors Locomotive — a GUARANTY with every Genuine GM Replacement Part

Beyond the Warranty you receive with each new General Motors Diesel locomotive, Electro-Motive gives you the added protection of a Guaranty on every genuine General Motors replacement part.

This unique policy of a locomotive builder guaranteeing spare parts (outlined in our General Service Bulletin No. 528 dated April 10, 1948) completes the owner's protection against defective material and/or workmanship following termination of the Warranty on new locomotives.

This policy is clearly defined, practical and fair. It provides a "make good" for any or all parts or assemblies adjusted under *either* Warranty or Guaranty. Replacement assemblies sold on Unit Exchange basis carry the same guaranty as any new replacement part. And our field-inspection service saves you transportation costs to our plant.

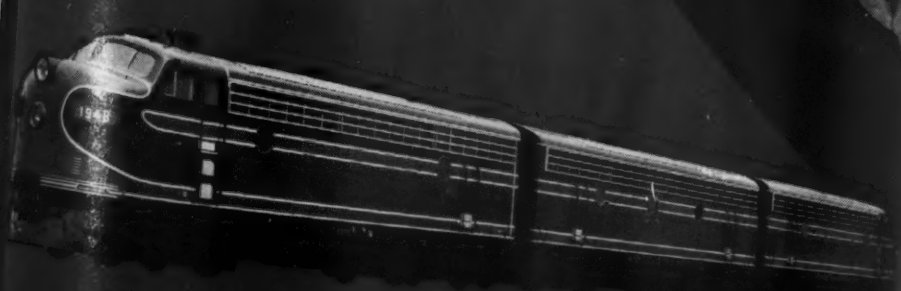
Here's another of the many *plus* values that go with your purchase of General Motors locomotives—good reason, too, why it pays to buy only genuine General Motors parts for General Motors locomotives.



ELECTRO-MOTIVE DIVISION

GENERAL MOTORS · LA GRANGE, ILL.

Home of the Diesel Locomotive



GENERAL MOTORS LOCOMOTIVES

BE&S standard air brake repair parts are more than mere duplicates of the original parts. They are *improved* duplicates. Although accurately gauged to size, BE&S parts are improved in quality of material and workmanship, and, in many cases, of improved design. Constantly on the alert for better ways of making air brake parts, BE&S engineering and research has originated improvements that are now standard on many roads. Keep in touch with us—we can help you effect important economies in your air brake department.

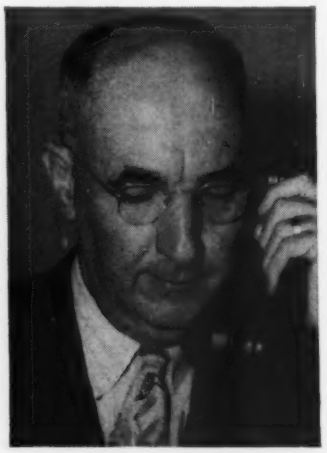
Brake Equipment & Supply Division
H. K. PORTER COMPANY, Inc.
Chicago 38, Ill. Pittsburgh 22, Pa.
District Offices in Principal Cities

ginia Polytechnic Institute (1929) with a B.S. degree in mechanical engineering. He entered railroad service on June 16, 1924, as extra clerk with the R. F. & P. and during the summers of 1925-1928 served as a draftsman at Richmond, becoming a special apprentice on July 1, 1929, and a machinist on November 16, 1931. He was appointed air-conditioning supervisor on January 1, 1935, and engineer of motive power on September 1, 1941.

H. G. SMITH has been appointed superintendent of motive power of the International-Great Northern with headquarters at Palestine, Tex.

F. G. FOSTER, chief mechanical officer of the Ontario Northland at North Bay, Ont., has retired.

ARTHUR SELBEE, who has been appointed superintendent of motive power and car equipment of the Central Vermont at St. Albans, Vt., as reported in the November issue, is a native of Battle Creek, Mich. He entered railway service with the Grand Trunk Western lines of the Canadian National in 1910 as a machinist apprentice at Battle Creek. Five years later he became enginehouse foreman at Durand, Mich, and in 1918



Arthur Selbee

assistant foreman of the erecting shop at Battle Creek. From 1924 to 1932 he served as a locomotive inspector, working out of Battle Creek, supervising construction of locomotives for system lines in the shops of the American Locomotive Works at Schenectady, N. Y.; the Baldwin Locomotive Works at Philadelphia, Pa., and the Kingston Locomotive Works at Kingston, Ont. In 1932 he became machine shop foreman, Grand Trunk Western, at Battle Creek and in 1945 shop superintendent.

HARRY M. WOOD, whose appointment as assistant chief of motive power—car of the Pennsylvania at Philadelphia, was reported in the November issue, was born at Altoona, Pa., on June 4, 1901. He is a graduate of Pennsylvania State College. He entered the service of the Pennsylvania as a clerk in the Altoona shops on July 7, 1919, and became a machinist apprentice on June 15, 1922. After several promotions at Altoona,

Harrisburg and Pittsburgh, Pa., Mr. Wood became master mechanic of the Long Island on August 1, 1937. He returned to the Pittsburgh division of the P.R.R. in May, 1941, as acting master mechanic and seven months later was appointed master mechanic of the Western Pennsylvania general division, consisting of the Pittsburgh, Conemaugh

Harry M. Wood

and Monongahela divisions. On February 16, 1942, Mr. Wood was appointed superintendent of the Logansport (Ind.) division and general superintendent of motive power of the Western region at Chicago on July 1, 1943.

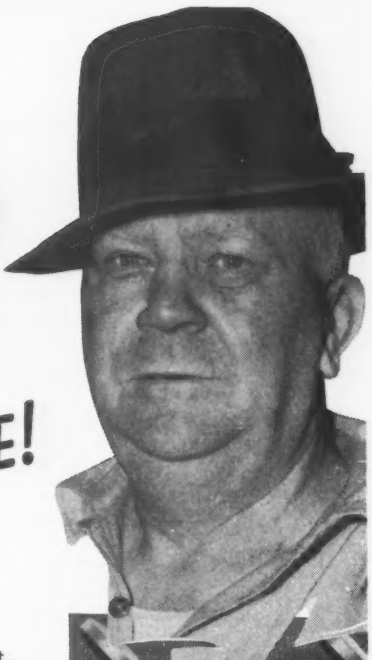
HAROLD C. WRIGHT, whose promotion to general superintendent of motive power, Western region, of the Pennsylvania, with headquarters at Chicago, was reported in the November issue, was born at Altoona, Pa. After graduating from Pennsylvania State College, he became a storehouse attendant on the Pennsylvania at Altoona in 1911. In 1921

H. C. Wright

he was advanced to motive-power inspector, and three years later became gang foreman at Olean, N.Y. Mr. Wright was appointed assistant master mechanic of the Pittsburgh division in 1935, and later served on other divisions until his appointment as master mechanic of the Williamsport division in 1940. He was transferred to Altoona in 1942 and became superintendent of motive power at Pittsburgh, Pa., in 1945.

SAFE FLOORS?

BROTHER, GIVE ME 4-WAY FLOOR PLATE!



This man's right, Mr. Management. Workers appreciate the extra safety they get when you install Inland's modern, skid-resistant flooring in your plant. Its 4-way safety lug pattern provides built-in protection and economy wherever feet or equipment must go . . . floors, walkways, ramps, platforms, steps.

What's more, Inland 4-Way Floor Plate reduces maintenance problems. It won't burn, warp, crack, splinter, or absorb liquids, and it's easily installed. Stocked by leading warehouses.

Write for Booklet

INLAND STEEL COMPANY

38 S. Dearborn St., Chicago. Sales Offices: Chicago, Davenport, Detroit, Indianapolis, Kansas City, Milwaukee, New York, St. Louis, St. Paul.

INLAND 4-WAY FLOOR PLATE

Extra yard profits from low cost handling with

ROUSTABOUT CRANES

. . The fast tractor-footed load-hustlers

● You've got a crane with hook or magnet anywhere you want it around your yard exactly when you want it—when a Roustabout is on the job. Fast, powerful, this mobile load-hustler gives you low cost materials handling outdoors all around your plant to match your indoor efficiency. It keeps things organized, on the move, prevents costly delays—no waiting for crews from other jobs. Built for years of overwork—ball-bearing boom turntable, all gears in oil. Capacities to 7½ tons—it's the answer to your yard problem. For complete facts . . . write to Dept. G-6.

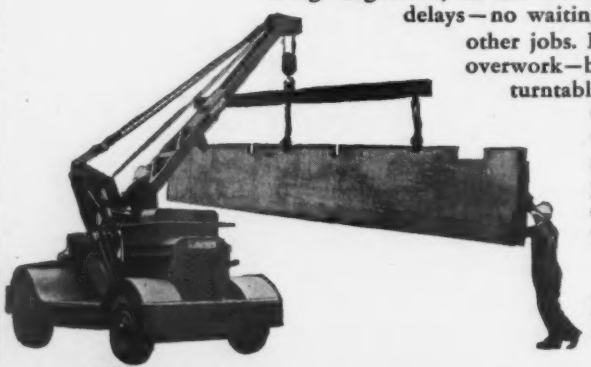


Photo courtesy of Industrial Power Division, International Harvester Company

ROUSTABOUT CRANE

HUGHES-KEENAN CORPORATION
DELAWARE, OHIO, U. S. A.
Load-Handling Specialists since 1904

DURAMETALLIC
Locomotive Packings

for STOKER ENGINES

Designed to give *long uninterrupted* service on all types of locomotive stoker engines.

STYLE D & B-911

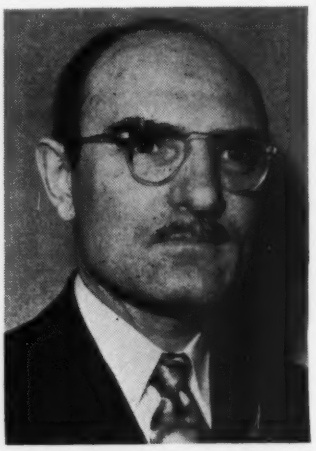
Durametallic Stoker Engine Packings are engineered to KEEP CONDENSATE OUT OF THE CRANK CASE. Supplied in die-molded ring sets ready to install in standard stuffing boxes.

On your request we will be glad to send our "Locomotive Packing Bulletin" covering various types of Durametallic Packings to meet your needs.

The PERFECT SEAL

DURAMETALLIC CORPORATION
KALAMAZOO MICHIGAN

M. C. HABER, whose appointment as general mechanical engineer of the Union Pacific, with headquarters at Omaha, Neb., was reported in the October issue, entered U. P. service in 1922 as a tracer in the motive power department at Omaha and later served as draftsman and engineer of road tests. In 1936 he was appointed mechanical engineer and in 1946 assistant general mechanical engineer.



M. C. Haber

Diesel

E. A. ANESI has been appointed Diesel instructor of the New York Central System, with headquarters at New York.

J. G. HUNT, general Diesel instructor of the New York Central system at New York, has been appointed general supervisor Diesel locomotive maintenance, with headquarters at New York.

E. L. HYATT has been appointed superintendent of shop, West Springfield Diesel shop of the New York Central System, with headquarters at West Springfield, Mass.

E. H. HOLLOWAY, supervisor of Diesel maintenance of the Central of Georgia at Macon, Ga., has been appointed to the newly created position of superintendent Diesel maintenance, with headquarters at Macon. Mr. Holloway entered the employ of the Central of Georgia in 1922

E. H. Holloway

NAILABLE STEEL FLOORING for boxcar use is ribbed to minimize the weight of steel needed for high resistance to surface deflection. Channels are coated with a tough, non-spalling composition that fills the rib depressions providing a level, skid-resistant surface.

*NAILABLE STEEL FLOORING

Cuts Railway Operating Costs... Relieves Shippers' Car Supply Problems

How often must shippers kick cars out empty because the floors aren't good enough for the particular outbound lading? How much time and money is spent switching boxcars—to spot them for loading according to the floor condition? The answers are *too often* and *too much*—because wood floors in most cars soon become damaged and car classifications must be reduced. Then cars must be shunted around empty until a load is available for which the floor is suited. This extra switching of Class B cars and rough-freighters not only cuts into shippers' car supply—it raises railway operating costs.

NAILABLE STEEL FLOORING eliminates much of this extra switching because it stays in Class A condition *longer*. It isn't damaged by nailing, pinch bars, abrasive freight or loading equipment. It has the strength to support the largest fork trucks used in boxcars. NAILABLE STEEL FLOORING is built to last as long as the car itself and stay in Class A condition during that time. Here is an all-purpose floor that *stays* that way, that can make major savings in operating expenses and provide substantial relief for car supply problems.

YOU SAVE 3 WAYS

In boxcars, flats and gondolas, the long life of NAILABLE STEEL FLOORING means lower repair and replacement costs as well as lower operating costs. And because it holds nails tighter and won't splinter, goods are safer on NAILABLE STEEL FLOORING. It saves you money in three ways—in operations, maintenance, and damage claims.

NAILABLE STEEL FLOORING
A GREAT LAKES STEEL PRODUCT

*PATENTS PENDING

GREAT LAKES STEEL CORPORATION

STEEL FLOOR DIVISION, PENOBSCOT BLDG., DETROIT 26, MICHIGAN
UNIT OF NATIONAL STEEL CORPORATION

Bakes or Dries
Coils & Armatures
Automatically
NO Watching • NO Timing

- Hi-volume horizontal air flow.
- Automatic heat control.
- Positive fresh air intake.
- Controlled volatile exhaust.
- Uniform temperature.
- Economical to operate.
- Easy to load and unload.

HERE'S AN OVEN that saves time on urgent motor repair jobs. This DESPATCH S Oven reduces baking time 25 to 35%, and bakes *automatically*—without watching or timing!

Average load for this 6'x6'x6' oven is 72 armatures and 100 complete coil sets. Daily capacity is 216 armatures, 300 complete coils. Temperature: 300°F. to 450°F. Time: variable up to 6 hours—ave. 4 hours at 300°F. Direct gas fired convection heat . . . automatic, safe (Factory Mutual approved).

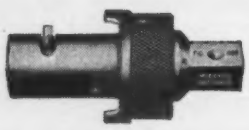
DESPATCH OVEN COMPANY
Minneapolis Office: 619 S.E. 8th St.
Chicago Office: 221 N. LaSalle St.
Offices in All Principal Cities

GREAT NORTHERN Shops, St. Paul, bakes two 3-ton 36" diameter armatures for diesel-electrics in 12 hours with this DESPATCH Oven.

DESPATCH OVEN COMPANY

WRITE TODAY for information

WIEDEKE
Expanders and Cutters for Efficient Operation



SPECIALISTS in the manufacture of:
Ideal Sectional Expanders, universally used to expand flue tubes in locomotive flue sheets. The accurately machined, interchangeable sections form a true circle when fully expanded.

Ideal Safety Power Cutters will cut flues off in one revolution, with a clean-square edge for safe ending.

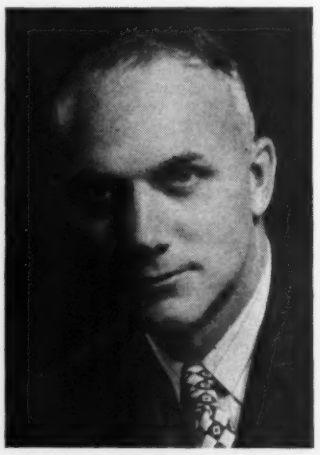
Write for IDEAL CATALOG No. 57

The Gustav Wiedeke *Company*
DAYTON 1, OHIO

as assistant draftsman, subsequently serving as draftsman and mechanical assistant. In April, 1942, he became supervisor of Diesel maintenance.

J. T. SHEEHAN has been appointed general Diesel instructor of the New York Central System, with headquarters at New York.

W. F. SINCLAIR has been appointed to the newly created position of general supervisor of Diesel equipment of the Canadian Pacific, with headquarters at Montreal, Que. Mr. Sinclair was born and educated in Dundee, Scotland. He became a machinist apprentice in the employ of the Canadian Pacific at Winnipeg, Man., in 1916, and advanced to the position of shop engineer in 1936. Mr. Sinclair had been on loan to the research department of the railroad since



W. F. Sinclair

1946 as research assistant and senior research engineer, assigned to a series of studies on Diesel power. During the war he was engaged in the munitions work of the Canadian Pacific at Montreal.

Shop and Enginehouse

HERMAN I. ANDERSON has been appointed acting superintendent of shops of the Missouri Pacific, with headquarters at North Little Rock, Ark.

JOHN P. WHALEN, superintendent of shops of the Missouri Pacific at North Little Rock, Ark., has been granted a sick leave.

Electrical

C. L. HALL has been appointed assistant superintendent electric equipment of the New York Central System at Harmon, N. Y.

Master Mechanics and Road Foremen

F. D. KENNEDY, master mechanic of the Erie at Marion, Ohio, has been transferred to Buffalo, N.Y.

G. E. LUND, whose appointment as acting district master mechanic of the Western district of the Erie at Meadville, Pa., was reported in the November issue, has been appointed district master mechanic of that district.

BALANCING

RAILROAD ELECTRICAL EQUIPMENT

Accuracy Pays Big Dividends in Maintenance Work

DYNETRIC BALANCERS — GISHOLT

DEVELOPED JOINTLY WITH WESTINGHOUSE ELECTRIC CORPORATION
"DYNETRIC" IS A TRADE MARK REG. U. S. PAT. OFFICE BY WESTINGHOUSE ELECTRIC CORPORATION

IF IT'S WORTH BALANCING AT ALL, IT'S WORTH DOING WELL. For the accuracy of balance determines the extra service a rotating part will deliver. That's reason enough for insisting upon Gisholt DYNETRIC Balancers.

Bearing Life Increased from 8 to 12 Times

Maintenance records in this large southwestern railroad shop show that bearing life is from 8 to 12 times longer when rotating parts are properly balanced on Gisholt DYNETRIC Balancing Machines.

The DYNETRIC 3-S Balancing Machine shown here (balancing air circulating fans for coaches) may be used for balancing many sizes and types of motors and generators used on Pullman, coach and locomotive equipment. After repairing or rebuilding, balance is restored quickly, easily—and *accurately!*

Gisholt engineers, familiar with all types of balancing problems, will gladly advise you on yours.

THE GISHOLT ROUND TABLE

represents the collective experience of specialists in machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

GISHOLT MACHINE COMPANY
Madison 10, Wisconsin

TURRET LATHES • AUTOMATIC LATHES • BALANCERS • SUPERFINISHERS • SPECIAL MACHINES

There's a new song on the rails!

When it comes to locomotives . . .

It heralds the arrival of something new
on the tracks of America
. . . the latest achievement in
Diesel-electric locomotive design.

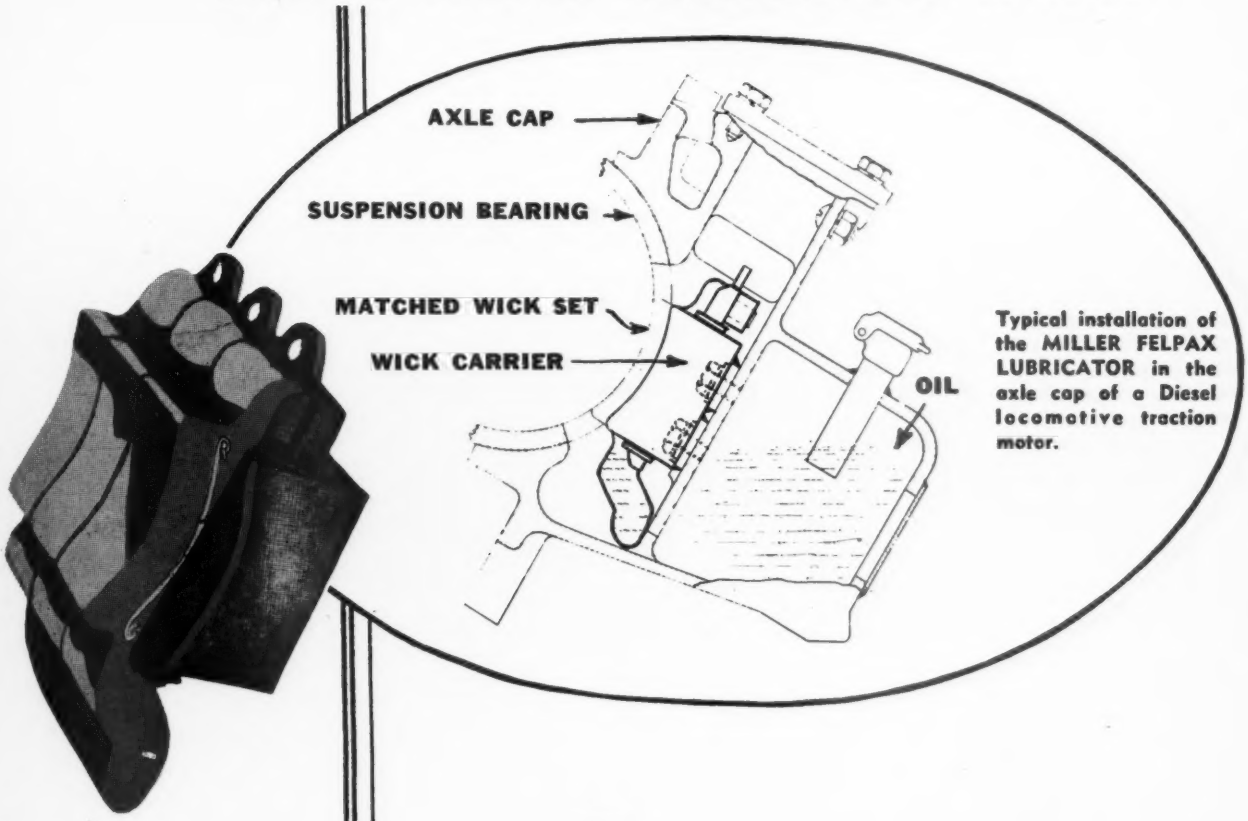
FAIRBANKS-MORSE

A name worth remembering

DIESEL LOCOMOTIVES • DIESEL ENGINES
STOKERS • SCALES • MOTORS • GENERATORS
PUMPS • FARM EQUIPMENT • MAGNETOS
RAILROAD MOTOR CARS and STANDPIPES

Here's how

MILLER FELPAX LUBRICATORS function:



Typical installation of the MILLER FELPAX LUBRICATOR in the axle cap of a Diesel locomotive traction motor.

THESE wicks deliver **full oil feed** to a traction motor suspension bearing across its full width, **uniformly.** Result: FELPAX Lubricators prevent excessive localized heating of journal surfaces . . . increase availability of power . . . greatly increase bearing liner life . . . reduce by as much as 75% wheel change-outs due to lateral and radial wear on the suspension bearings.

Millions of miles of trouble-free service on 30 of the nation's Class I railroads.

For full particulars see your locomotive builder, or write to

MILLER FELPAX CORPORATION
WINONA, MINNESOTA

IF IT'S A TOUGH JOB

On the Union Pacific, sleek-nosed Alco-G.E. 6000-hp passenger diesel-electrics snake 1200-ton trains over the winding 2.2 percent Cajon hump at maximum permissible speeds. Similarly, their design twin, the 1500-hp Alco-G.E. freight unit, in multiples of four, makes the same eastbound run with 75-car, 3000-ton drags. Westbound ratings are even higher—2000 tons for the passenger locomotives, 4000 tons for the freighters.

These tonnage ratings, the highest for this run, are assigned exclusively to Alco-G.E. equipment.

How do they do it? Turbosupercharged, 4-cycle power evenly applied to all driving axles by a superfast control system supplies part of the answer. Unusually high short time and continuous ratings of the traction motors supply the rest. Not only have these high-capacity motors proven their superiority in handling heavy loads at high speeds upgrade, but they can ease these same heavy loads down the mountain. Exceptionally high dynamic braking effort downgrade greatly reduces the need for application of air brakes.

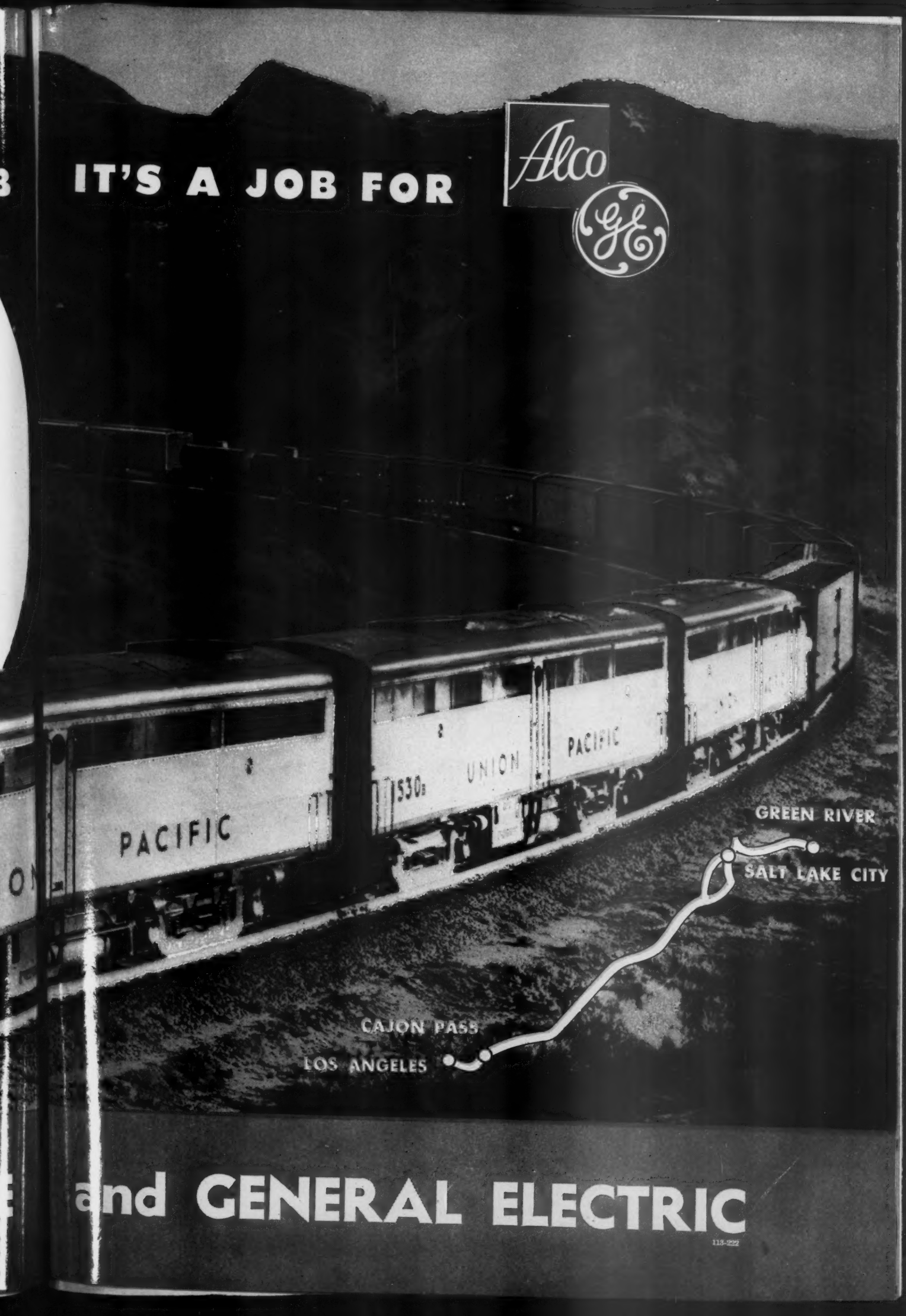
The Union Pacific is currently assigning unit after unit of Alco-G.E. power to most of its toughest jobs. All three road types—2000-hp passenger, 1500-hp freight, 1500-hp road switcher—are supplemented by 1000-hp switchers. An Alco-G.E. representative is available in your area to show you how these same diesel-electrics can increase your railroad's earning power—by doing its toughest jobs.

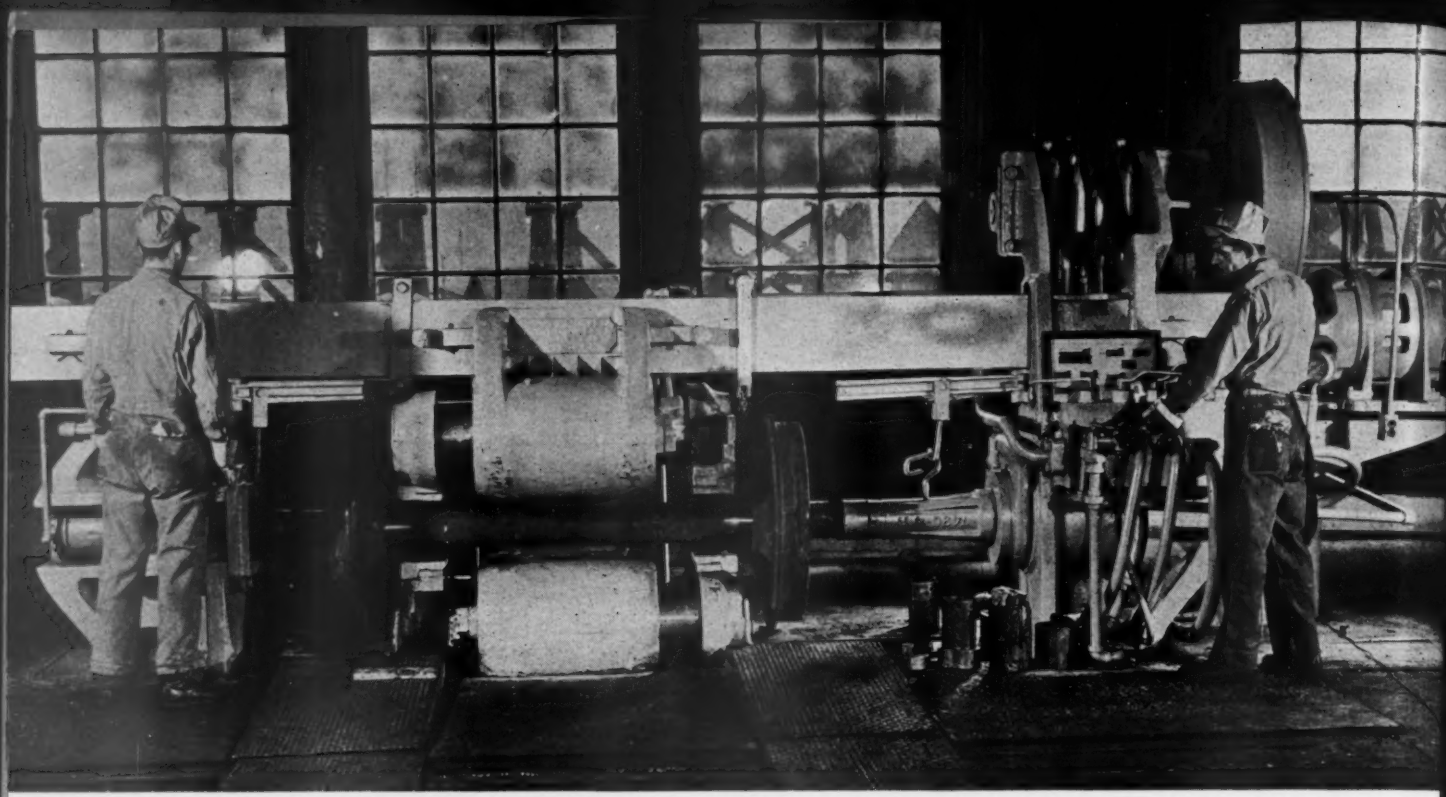
Built TO DO YOUR RAILROAD'S TOUGHEST JOBS

Alco

GE

AMERICAN LOCOMOTIVE


IT'S A JOB FOR
Alco
GE
PACIFIC
UNION
PACIFIC
5308
GREEN RIVER
SALT LAKE CITY
CAJON PASS
LOS ANGELES
and GENERAL ELECTRIC
113-222

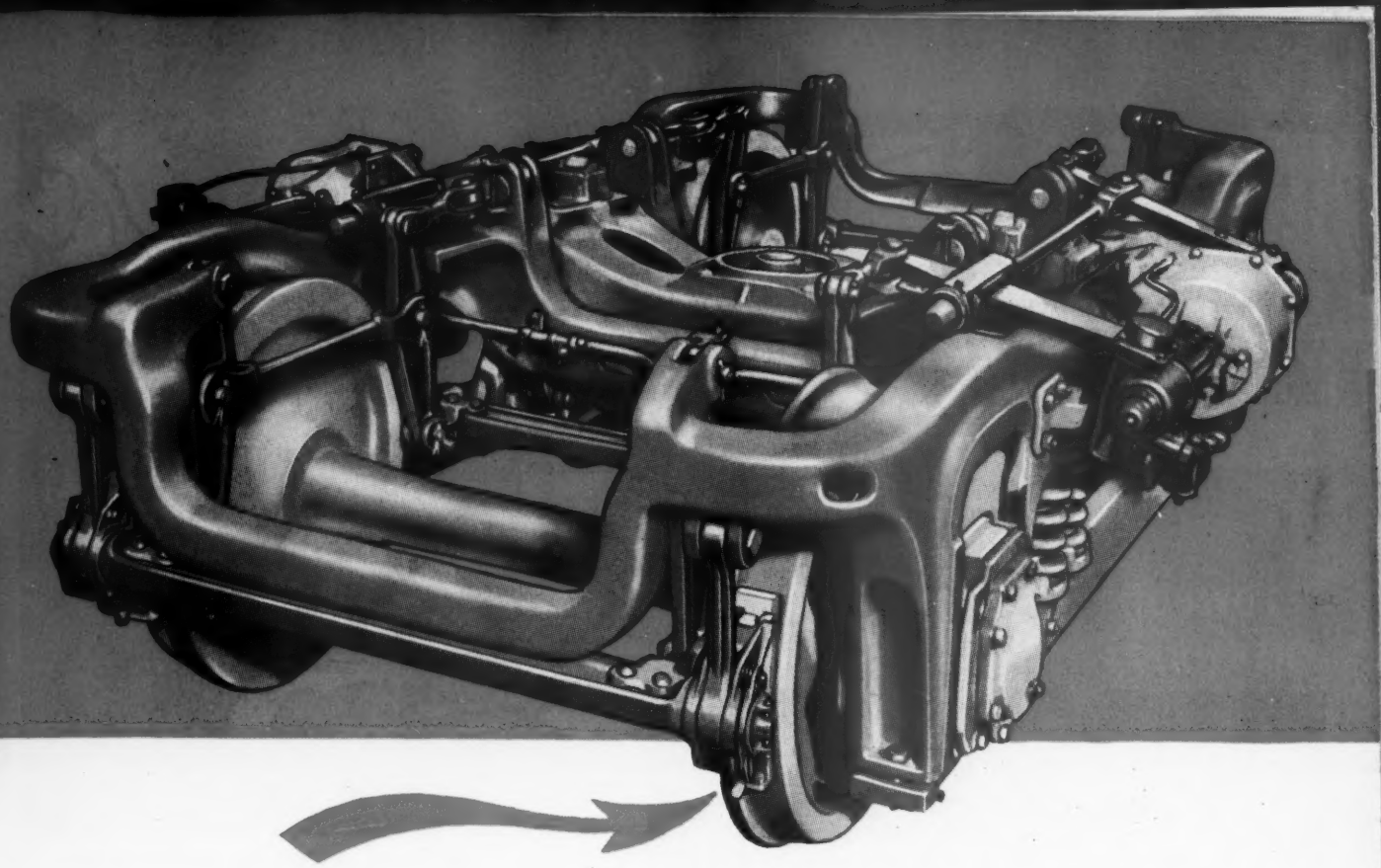


CHAMBERSBURG DUPLEX WHEEL PRESS STRIPPING BOTH WHEELS AT ONCE AT B. & O. WHEEL SHOP, GLENWOOD, PA.

Because the floor-to-floor wheel-stripping time of the Chambersburg Duplex Wheel Press—frequently clocked at 42 seconds—is unequalled by any other method, it more than meets the requirements of the centralized wheel shop.

CHAMBERSBURG ENGINEERING COMPANY, CHAMBERSBURG, PA.

STRIPPING TWO DIESEL WHEELS AND GEAR SIMULTANEOUSLY AT N. Y. O. & W. SHOPS, MIDDLETOWN, N. Y.



ON-THE-WHEEL BRAKING

means Shorter, SAFER Stops

You don't want brakes that just stop the wheels. You want brakes that will *stop the train!* And to do this quickly, surely, ample traction is needed. The effective adhesion between wheels and rails can mean the *difference* between danger and safety.

WHY BRAKE-SHOE BRAKING IS BETTER . . . Simplex *brake-shoe* braking wipes wheel treads clean of foreign matter picked up from the road-bed . . . conditions the treads for braking. And the resulting better wheel-rail contact *improves* effective adhesion.

MAXIMUM EFFECTIVE ADHESION AT ALL SPEEDS . . . Equally important to efficient, dependable Simplex braking is *this* fact: the simple Simplex design adds *not a single pound* to the weight of the rotating truck parts. Thus, undesirable pressure variation at the rails—caused by dynamic augment (rotational unbalance)—*cannot* be aggravated, and maximum effective adhesion between wheels and rails is maintained at *all train speeds.*

Streamlined, Light-Weight

SIMPLEX UNIT CYLINDER CLASP BRAKES

AMERICAN STEEL FOUNDRIES

REG. U.S. PAT. OFF. FINE CAST STEEL

INCO OFFERS EXPERIENCED COUNSEL ON METAL PROBLEMS

Avail yourself of experienced counsel on problems relating to the properties, treatment, fabrication or performance of ferrous and non-ferrous metals containing nickel.

We offer consultation . . . and invite you to write, wire or phone the INCO Technical Field Section or Stock and Service Center nearest to your plant.

"INCO" TECHNICAL SECTIONS

Consultation on technical problems relating to alloys containing nickel is invited. Consult the nearest Technical Field Section of INCO Development and Research Division listed below:

CANADIAN SECTION
25 King Street, West,
Toronto 1, Ont.
Tel. Elgin 7471

CENTRAL ATLANTIC COAST SECTION
67 Wall Street,
New York 5, N. Y.
Tel. Whitehall 4-1000

CHICAGO SECTION
333 N. Michigan Avenue,
Chicago 1, Ill.
Tel. Franklin 4030

CINCINNATI SECTION
Carew Tower,
Cincinnati 2, Ohio
Tel. Parkway 1632

DETROIT SECTION
General Motors Building,
Detroit 2, Mich.
Tel. Madison 3436

EMPIRE STATE SECTION
Genesee Valley Trust Bldg.,
Rochester 4, N. Y.
Tel. Main 2393

NEW ENGLAND SECTION
75 Pearl Street,
Hartford 3, Conn.
Tel. Hartford 7-0383

PITTSBURGH SECTION
Grant Building,
Pittsburgh 19, Pa.
Tel. Atlantic 9546

ST. LOUIS SECTION
Ambassador Bldg.,
St. Louis 1, Mo.
Tel. Garfield 4197

TEXAS SECTION
Commerce Bldg.
Houston 2, Texas
Tel. Charter 4-4234

TWIN CITIES SECTION
Northwestern Bank Bldg.,
Minneapolis 2, Minn.
Tel. Geneva 0631

WEST COAST SECTION
Petroleum Bldg.,
Los Angeles 15, Calif.
Tel. Prospect 2496

STOCK AND SERVICE CENTERS FOR "INCO" PRODUCTS

The following are sources of supply for primary nickel for alloying purposes. Through casting specialists, they are prepared to offer technical service on the production of ferrous and non-ferrous castings containing nickel.

ATLANTA 3
J. M. Tull Metal & Supply Co.
285 Marietta Street
Tel. Walnut 3525

BALTIMORE 17
Whitehead Metal Products Company, Inc.
413 West North Avenue
Tel. Lafayette 2300

BUFFALO 2
Whitehead Metal Products Company, Inc.
254 Court Street
Tel. Cleveland 1475

CAMBRIDGE 39, MASS.
Whitehead Metal Products Company, Inc.
281 Albany Street
Tel. Trowbridge 6-4680

CHICAGO 23
Steel Sales Corporation
3348 South Pulaski Road
Tel. Bishop 7700

CINCINNATI 14
Williams and Company, Inc.
1921 Dunlap Street
Tel. Cherry 4700

CLEVELAND 14
Williams and Company, Inc.
3700 Perkins Avenue
Tel. Express 7000

COLUMBUS 15, OHIO
Williams and Company, Inc.
31 North Grant Avenue
Tel. Main 3291

DALLAS 9
Metal Goods Corporation
6211 Cedar Springs Road
Tel. Dixon 4-3925

DENVER 2
Metal Goods Corporation
817 Seventeenth Street
Tel. Main 9030

DETROIT 10
Steel Sales Corporation
5151 Wesson Avenue
Tel. Tyler 6-3000

HOUSTON 3
Metal Goods Corporation
711 Milby Street
Tel. Beacon 3-8881

INDIANAPOLIS 2
Steel Sales Corporation
1916 North Meridian Street
Tel. Talbot 8-1506

KANSAS CITY 2, MO.
Steel Sales Corporation
39th & Main Streets
Tel. Jefferson 1080

LOS ANGELES 21
Pacific Metals Company, Ltd.
1400 South Alameda Street
Tel. Prospect 0171

MILWAUKEE 4
Steel Sales Corporation
647 West Virginia Street
Tel. Daly 8-6840

MINNEAPOLIS 15
Steel Sales Corporation
529 South 7th Street
Tel. Nestor 6614

MONTREAL 3
Robert W. Bartram, Limited
277 Duke Street
Tel. Marquette 3281

NEWARK 5
Whitehead Metal Products Company, Inc.
205 Prelinghuysen Avenue
Tel. Bigelow 8-8500

NEW HAVEN 13
Whitehead Metal Products Company, Inc.
265 Church Street
Tel. New Haven 8-0275

NEW ORLEANS 12
Metal Goods Corporation
432 Julia Street
Tel. Canal 7373

NEW YORK 14
Whitehead Metal Products Company, Inc.
303 West 10th Street
Tel. Watkins 4-1500

PHILADELPHIA 40
Whitehead Metal Products Company, Inc.
1955 Hunting Park Avenue
Tel. Baldwin 9-2323

PITTSBURGH 12
Williams and Company, Inc.
901 Pennsylvania Avenue
Tel. Cedar 8600

PORTLAND 4, ORE.
Eagle Metals Company
809 Dekum Building
Tel. Atwater 4962

ROCHESTER 4
Whitehead Metal Products Company, Inc.
217 East Avenue
Tel. Stone 3093

ST. LOUIS 10
Steel Sales Corporation
4565 McRee Avenue
Tel. Grand 5255

SALT LAKE CITY 1
Pacific Metals Company, Ltd.
34 Richards Street
Tel. Salt Lake City 4-7058

SAN FRANCISCO 10
Pacific Metals Company, Ltd.
3100 Nineteenth Street
Tel. Mission 7-1104

SEATTLE 4
Eagle Metals Company
3628 East Marginal Way
Tel. Elliot 4764

SPOKANE 8
Eagle Metals Company
328 West Trent Avenue
Tel. Main 2419

SYRACUSE 3
Whitehead Metal Products Company, Inc.
201 Burt Street
Tel. Syracuse 5-4112

TOLEDO 2
Williams and Company, Inc.
650 East Woodruff Avenue
Tel. Adams 8102

TORONTO 5
Alloy Metal Sales Limited
881 Bay Street
Tel. Midway 7335

TULSA 3
Metal Goods Corporation
302 North Boston Street
Tel. Tulsa 4-1175

VANCOUVER, B. C.
Wilkinson Company, Ltd.
190 West Second Avenue
Tel. Fairmount 6101

EMBLEM OF INCO SERVICE TRADE MARK

THE INTERNATIONAL NICKEL COMPANY, INC.

67 WALL STREET
NEW YORK 5, N. Y.

Delays...Failures...Rejects

SPECIFICATION Materials

Precisionized
THERMOSETTING COMPOUNDS

NO MATTER HOW large, how small or how intricate a piece you are called upon to mold—whatever realizable properties are required of the material — Interlake can supply a Makalot Compound *exactly suited* to your application.

Scores of leading molders now make it an invariable rule to try a Makalot Compound first.

There are low loss Makalot Compounds for high frequency applications, non-cracking for molding around inserts, non-shrinking, heat resistant, general purpose, super-impact, or with brilliant surface lustre—and—every one proved in successful use by some of the country's largest molders.

INTERLAKE CHEMICAL
Corporation
• PRODUCTS FROM COAL •

Interlake will supply a Specification Resin or a Makalot Compound exactly suited to your application. Write Interlake Chemical Corporation, Plastics Division, 1911 Union Commerce Bldg., Cleveland 14, Ohio.

ts

ls

HEYDEN Chemicals for

FORMALDEHYDE

37% U.S.P. Solution. Uniform in strength and high in purity. Low acid and metals content. Available in quantities to meet individual requirements — from tank cars of 72,000 lbs. to bottles of 1, 5 and 9 lbs.

PARAFORMALDEHYDE

Packaged in 100 pound drums. Powdered or granular types are available.

PENTEK*

(Pentaerythritol, Technical)

Used in alkyd resins, synthetic resins and coating compositions where good water resistance, rapid bodying, excellent durability and speedy drying is desired.

HEXAMETHYLENETETRAMINE

Technical granules and powder available. Packed in 200 pound barrels.

*Trade Mark — U. S. Pat. Off.

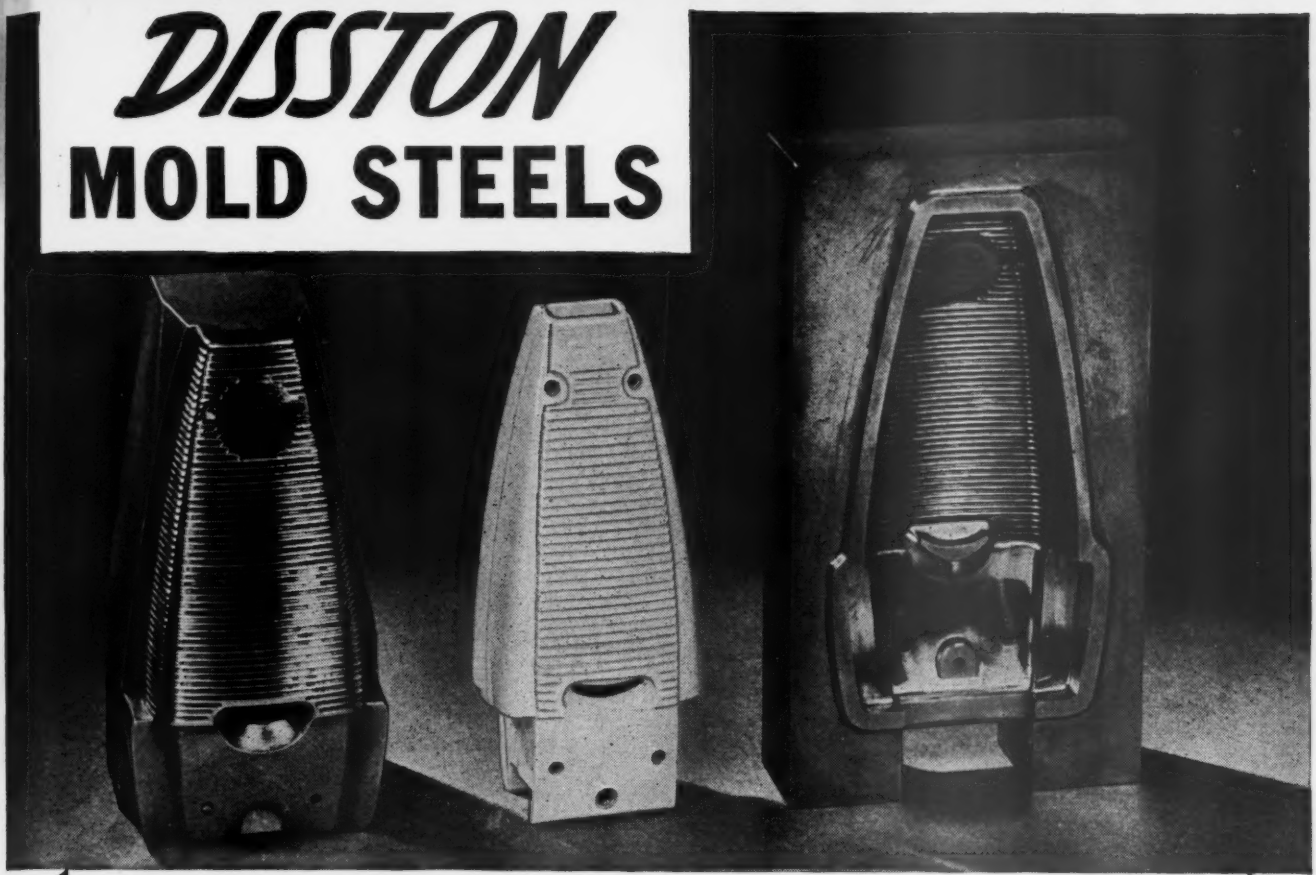
HEYDEN *Chemical Corporation*

393 SEVENTH AVENUE, NEW YORK 1, N. Y.

Chicago Sales Office: 180 N. Wacker Drive, Chicago 6, Ill.

Benzaldehyde • Benzoates • Benzoic Acid • Benzyl Chloride • Bromides • Chlorinated Aromatics • Medicinal Creosotes • Formates • Formaldehyde • Formic Acid Glycerophosphates • Medicinal Guaiacols • Hexamethylenetetramine • Paraformaldehyde • Parahydroxybenzoates • Penicillin • Pentaerythritols • Salicylates

DISSTON MOLD STEELS



WHATEVER THE METHOD OR PRODUCT THERE IS A DISSTON MOLD STEEL THAT WILL EXACTLY FIT THE JOB

Disston makes three types of steels for molds used in the manufacture of plastics products. Each is designed to fit a definite need. All are of exceptionally fine quality, produced in electric furnaces from carefully selected raw materials, and by modern steel practice with every process under careful control.

DISSTON PLASTIRON . . . a low carbon iron that withstands extreme hobbing, carburizes evenly, and produces smooth, clean cavities without soft spots. Recommended for difficult shapes and short runs.

DISSTON PLASTALLOY . . . a low carbon steel containing nickel and chrome, and alloyed so as to provide great core strength and resistance to wear yet permit easy hobbing. Recommended for medium runs and a wide variety of products.

DISSTON PLASTIKUT . . . a "cut mold" steel with high alloy content for maximum core and case strength. Because of its extra hardness, Plastikut must be machined instead of hobbed, but due to its ability to stand up under long runs it is highly efficient and economical.

All Disston Mold Steels are melted and hot-worked with great care . . . are specially inspected to assure freedom from porosity and inclusions. They are uniformly sound . . . carburize evenly . . . and produce unusually smooth cavities.

Whatever your mold or hob problems may be Disston engineers and metallurgists will be glad to help you solve them.

Write for Folder

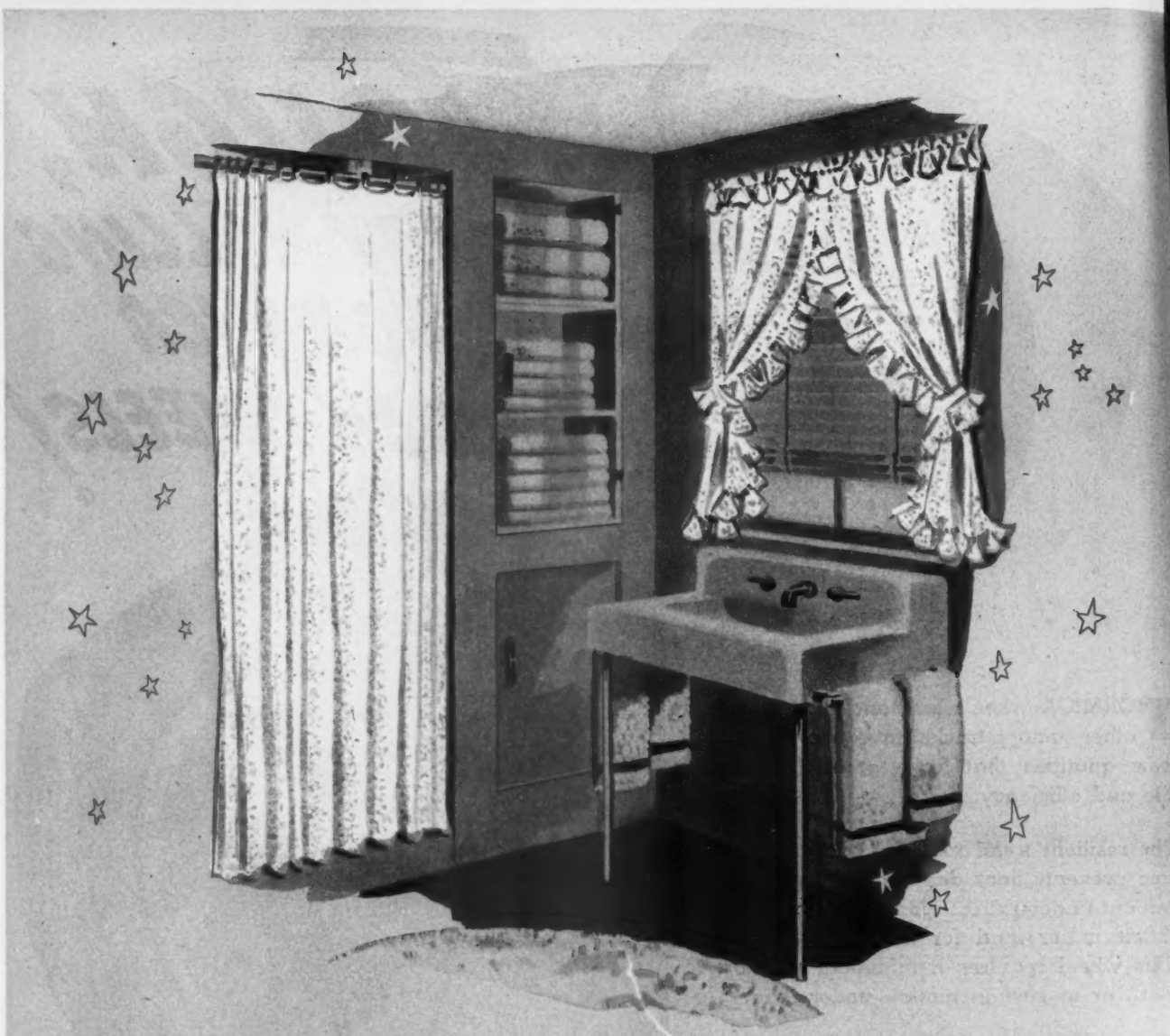
Tells briefly and clearly what to look for and what to avoid in selecting mold and hob steels. Also contains complete analyses of Disston Mold Steels and other helpful information.

HENRY DISSTON & SONS, INC., 634 Tacony, Philadelphia 35, Pa., U. S. A.

DISTRIBUTORS

NEW ENGLAND
Achorn Steel Company
381 Congress Street, Boston 10, Mass.

METROPOLITAN NEW YORK & NORTHERN NEW JERSEY
● Bright Steel Corporation Offices & Warehouses, 528-540 West 22nd Street, New York 11, N. Y. and 224-236 Culver Avenue, Jersey City 5, N.J.



LATEST "BATH SPLASH" BY PARA MANUFACTURING COMPANY

IN syntilite THE PLASTIC FILM OF FASHION

SYNTILITE provided the inspiration for Para's newest bathroom ensemble—matching shower and window curtains that combine beauty and utility with a new-age sort of magic.

SYNTILITE is the plastic film that's inspiring new creative design in so many fields today.

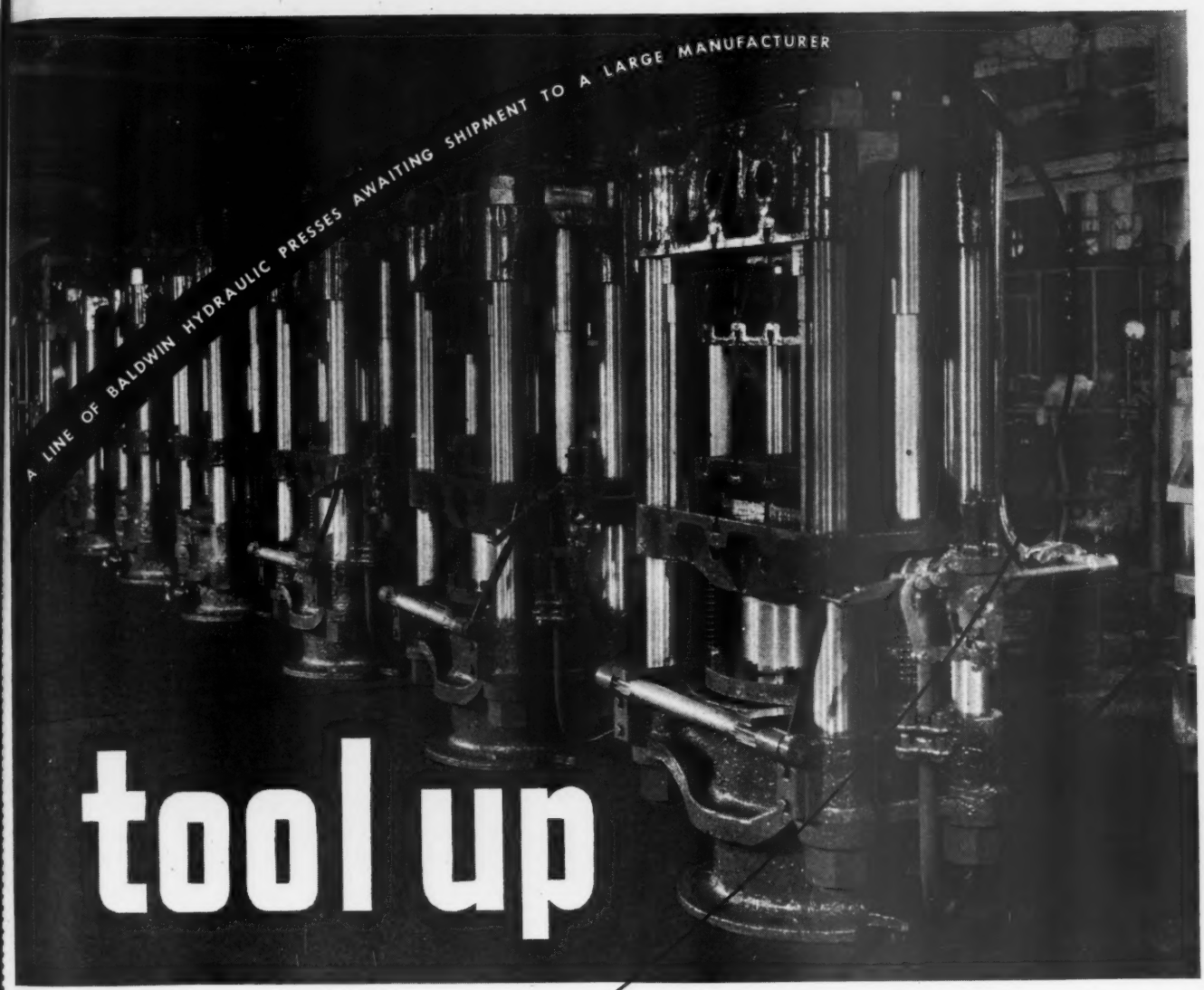
It has the warmth and softness of a woven fabric, is textured to sparkle with a million lights, comes in a range of glorious moon-struck colors.

SYNTILITE is water, spot and mildew-repellent and possesses a high degree of wear-resistance. It drapes and pleats without danger of cracking or peeling.

From now on, you'll see Syntilite in more and more fashions for the home and for the wardrobe. It is, definitely, the plastic film of fashion.

pfc PLASTIC FILM

PLASTIC FILM CORP. • Plant at Plainfield, Conn. • New York Office: 475 Fifth Ave., New York 17, N. Y.



tool up

FOR LOWER-COST PRODUCTION

With 130,000,000 customers clamoring to buy, every alert manufacturer is looking for proven methods of speeding and expanding production. Many are finding such a means in Baldwin Hydraulic Presses.

Baldwin Hydraulic Presses combine all the newest developments to step-up production, reduce rejects and provide for maximum safety and ease of operation. Models range from 50 to 500 tons.

A Baldwin Field Engineer will be glad to discuss plans with you, and recommend the Baldwin Hydraulic Press that will do the job best. Whatever the press, you'll find it offers an unusual combination: *custom-built* quality and features in a *standard* model. The Baldwin Locomotive Works, Locomotive & Southwark Division, Philadelphia 42, Pa. Offices: Philadelphia, New York, Chicago, St. Louis, Washington, Boston, San Francisco, Cleveland, Detroit, Pittsburgh, Houston, Birmingham, Norfolk.

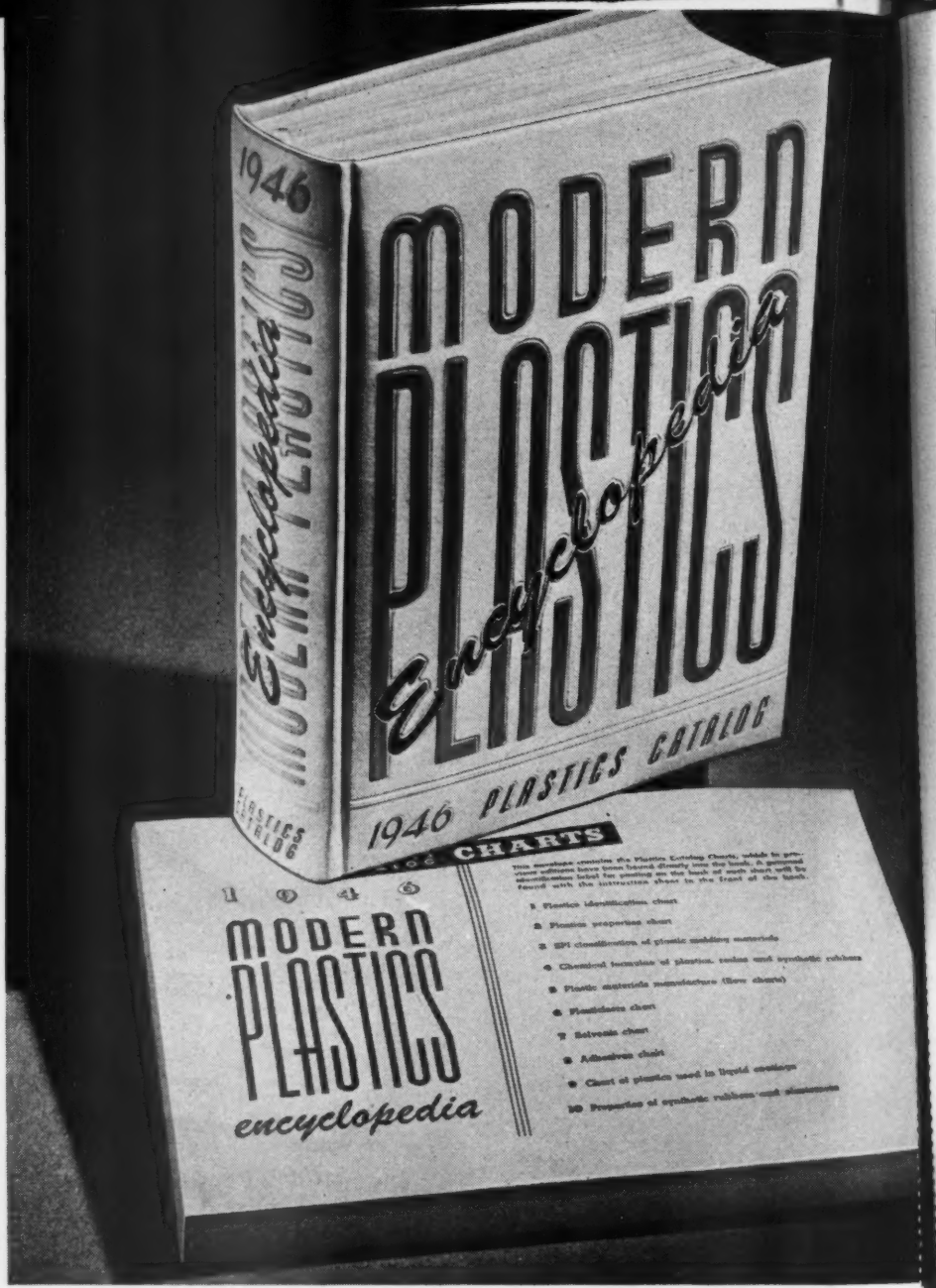
BLW THE BALDWIN GROUP

BALDWIN

SOUTHWARK

HYDRAULIC PRESSES

→ IT'S HERE!



At last—first copies of the 1946 MODERN PLASTICS ENCYCLOPEDIA are off the press. So huge—1390 folioed pages—with ten gigantic charts—you'll wonder how this tremendous volume, crammed with new material, new illustrations, new photographs, could be sold at so low a price!

This is truly the Encyclopedia of Plastics. Its 135 separate chapters detail every phase of plastics materials, machines, methods and applications. Its charts bulk so large that it was a physical impossibility to bind them into the Encyclopedia—so, this year you have them neatly folded into an envelope and with identifying labels for each.

The introductory section of the Encyclopedia is a condensed handbook of plastics—what they are, how they are made, how they are processed, and all their various points of utility. This section is a stimulant to the thinking of every plastics-conscious executive—and an inspiration to members of the industry as well.

A limited number of copies of the 20,000 printed this year still remain to be spoken for. At present rates of sale, the edition will be exhausted in a few weeks. The publishers urge every interested industrialist to place his order now.

Same low price as last year - - -

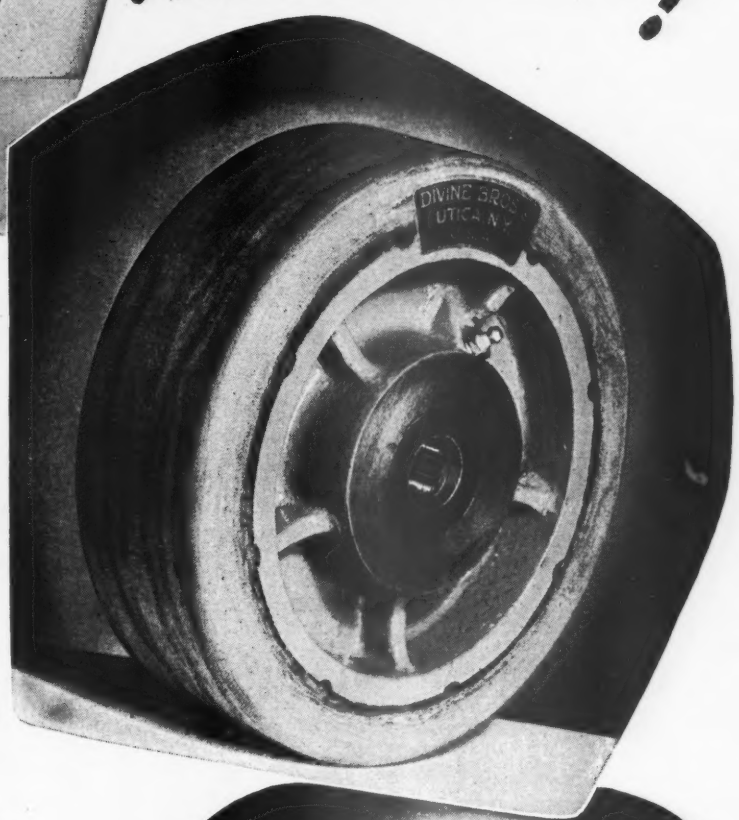
$6 a copy

$7 foreign and Canadian

PLASTICS CATALOGUE CORP.

122 EAST 42nd STREET • NEW YORK 17, N. Y.

TOUGH, EASY ROLLING FORMICA TRUCK WHEELS!



FORMICA wheels for hand lift trucks and other factory trucks have provided some new qualities that have greatly increased life and efficiency.

The resilient tread material operates quietly and prevents floor damage. It does not flatten out under extreme load, nor develop flats if left under load for an extended period. This wheel requires a minimum of effort to start, or to sustain motion under load.

Formica tires are chemically inactive and unaffected by petroleum, chemicals, water and most industrial acids. They can be used in temperatures as high as 250° F.

The tire is spark-proof and non-conductive, insulating the truck electrically from the floor. Formica tires may also be made with embedded conductors to prevent building up a static potential.

Formica tires are light—one-sixth the weight of steel. They have a remarkable record in service, and their use in industry generally is expanding very rapidly.

Distributed only by Divine Brothers Company
Utica, New York, U. S. A.

FORMICA

THE FORMICA INSULATION COMPANY, 4673 SPRING GROVE AVE., CINCINNATI 32, O.

Drying Processes with FW designed

DOWTHERM HIGH-TEMPERATURE LOW-PRESSURE HEATING

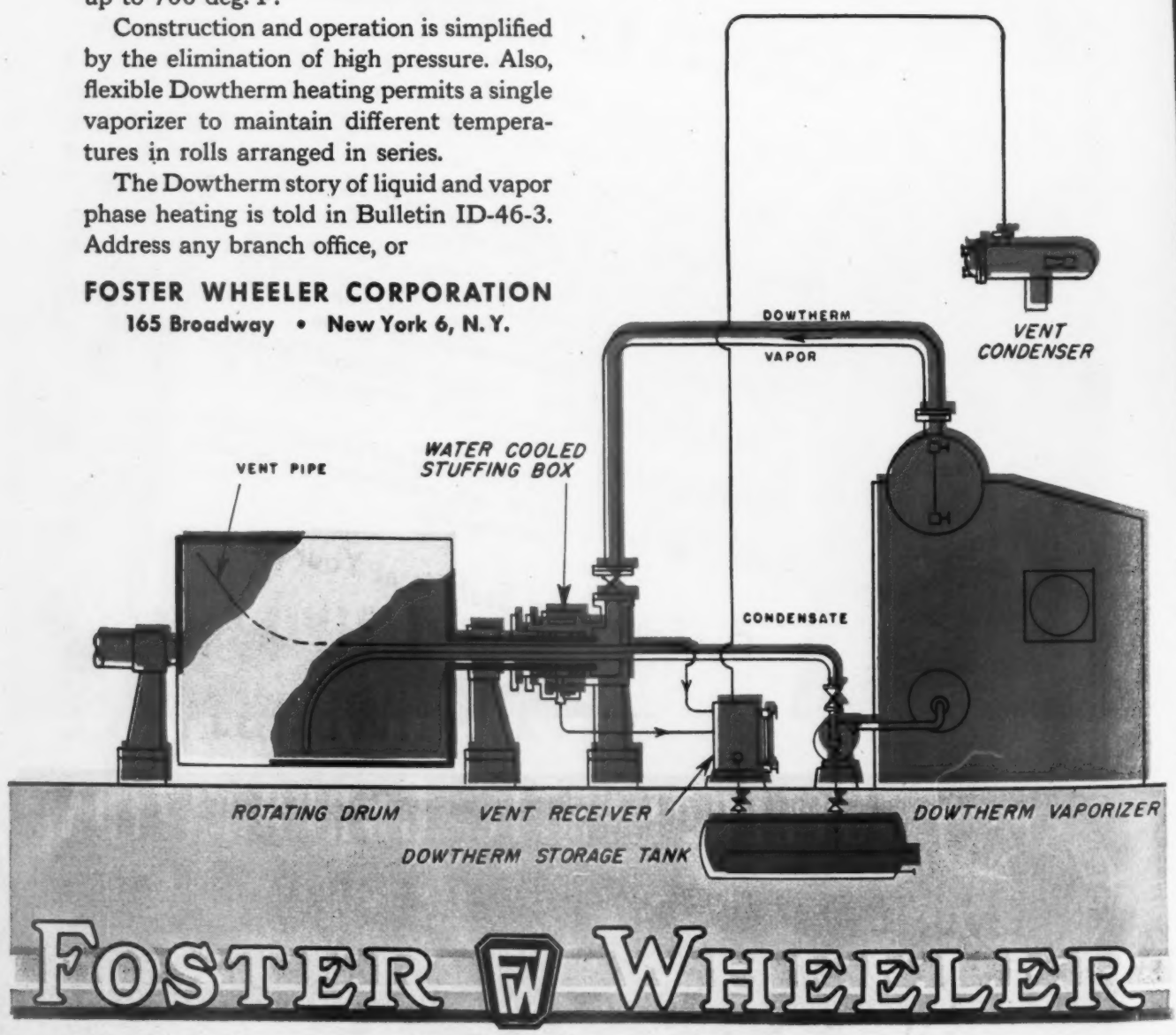
An exclusive Foster Wheeler service is design—then manufacture—of special-service heating systems. The unit illustrated shows one application of Dowtherm heating to drying rolls.

Dowtherm heating gives the unparalleled advantages of high temperature *without* high pressure. At 500 deg. F. these systems operate at atmospheric pressure, show only moderately increasing pressure up to 700 deg. F.

Construction and operation is simplified by the elimination of high pressure. Also, flexible Dowtherm heating permits a single vaporizer to maintain different temperatures in rolls arranged in series.

The Dowtherm story of liquid and vapor phase heating is told in Bulletin ID-46-3. Address any branch office, or

FOSTER WHEELER CORPORATION
165 Broadway • New York 6, N. Y.



FOSTER FW WHEELER

For Versatility in Plastic Molding you can depend on GRIGOLEIT

For 19 years we've supplied many nationally prominent manufacturers with parts and trim for their products. The *versatility* of our facilities and our molding experience enable us to create unusual design or standard plastic items.

For reasonably early availability, we offer an extensive "standard" line of handles, knobs and other parts for stoves, furniture and household appliances; also a large "stock" line of closures for foods, drugs and cosmetics.

We also maintain a complete custom-molding service in thermo-plastic and thermo-setting plastics. Operating our own metal and tool shops, we are able to insure perfect blending of plastics and metal.

Write for 1946 Catalog

THE GRIGOLEIT COMPANY

744 NORTH STREET
DECATUR 80, ILLINOIS

Simple or Intricate Parts **INJECTION** molded

Rods-Tubing-Tapes Special Forms in **EXTRUSION** molded

●

Also Manufacturers of Shatterproof PLASTIC CONTAINERS

We have facilities for producing a wide variety of products by extrusion or injection molding.

Intricate or simple parts by Injection, —up to 16 ounces per shot, including such items as handbag frames, first-aid boxes, toys, etc . . . .

Continuous lengths of Extrusion moldings in many diameters, various shapes; your choice of color, flexible and rigid, transparent and opaque.

Also "Victocel" Polyvinyl Chloride Sheeting in all colors, supplied in roll lengths.

Our plant is capable of handling your needs, with special emphasis on volume production.

●

Our Engineering Staff is at Your Service

CELLUPLASTIC ORP.

CELLUPLASTIC CORPORATION

PLASTIC CONTAINERS
AND
PLASTIC PRODUCTS

44 AVENUE L NEWARK 5, N. J.

NEW YORK OFFICE—630 FIFTH AVENUE WEST COAST CONTAINER SERVICE COMPANY, LOS ANGELES 21, CAL.

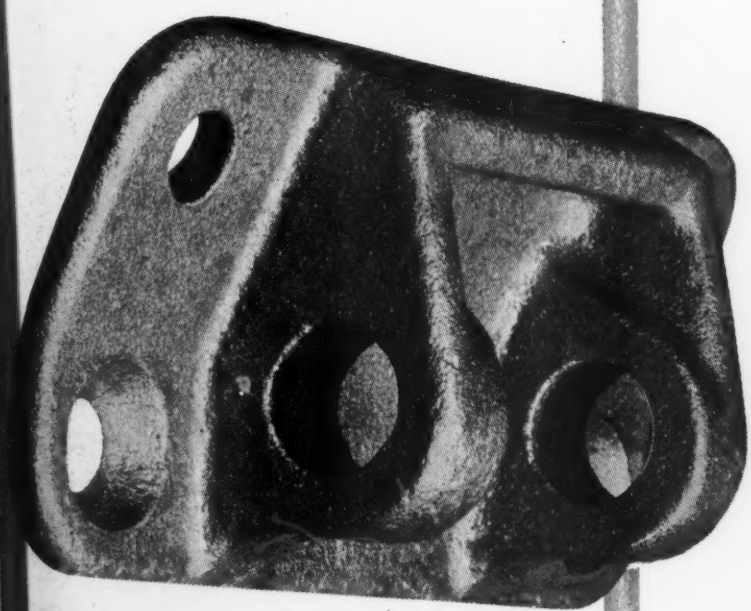
Transportation Library

December 1948

Railway Mechanical Engineer

Transportation Library

DEC 15 1948



The IMPORTANCE of SIMPLICITY!

As generally agreed by the nation's leading freight car designers . . . simplicity, wherever possible, will afford many plausible gains toward speedier, less costly construction and maintenance.

Dependable *cast steel* units exemplify this simplicity. Made in one piece . . . all sections are knit properly to one another and the job is *complete* within itself! No jigs or fixtures are required to sub-assemble parts and accurate alignment is assured! The metal is placed only where needed for strength without surplus bulk or weight and drilling is unnecessary.

And when it comes to *dependable* cast steel units, accurate to the n'th degree . . . *Unitcastings* will do your job *right!* Unitcast's Precision Mass Production methods will produce more *good* castings in less time and at a lower finished cost! Unitcast Corporation, Steel Casting Division, Toledo 9, O. In Canada: Canadian-Unitcast Steel, Ltd., Sherbrooke, Que.

UNITCAST
Corporation
ELECTRIC STEEL CASTINGS

"BUFFALO"
UNIT BRAKE BEAM

NEVER UNDERESTIMATE THE WORD "BUFFALO" WHEN YOU THINK OF UNIT BRAKE BEAMS

- "Buffalo" is the ORIGINAL Unit Brake Beam
- "Buffalo" is the TIME-TESTED Unit Brake Beam
- "Buffalo" is the SERVICE-TESTED Unit Brake Beam

Since 1937 more than 310,000 of these sturdy, solid-truss Unit-type "Buffalo" Brake Beams have been bought by 86 railroads and private car lines.

Less than 1/10 of 1% of these beams were s ically bought for stand-by stock or repairs.

NO OTHER BRAKE BEAM CAN APPROACH RECORD! "Buffalo" Units definitely STAND UP.

BUFFALO BRAKE BEAM C

140 Cedar Street New